RECORD OF DECISION
SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

REASOR CHEMICAL COMPANY SITE
CASTLE HAYNE, NEW HANOVER COUNTY, NORTH CAROLINA

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA, GEORGIA

SEPTEMBER 2002

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LIST OF ACRONYMS and ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Regulations
ATV	Alternate Toxicity Value
BDL	Below the laboratory Detection Limit
BHHRA	Baseline Human Health Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Chemical of Concern
COPC	Chemicals of Potential Concern
EPA	United States Environmental Protection Agency
EPA-OTS	EPA Region 4 Office of Technical Services
EPS	Exposure Pathway Scenarios
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
ESI	Expanded Site Inspection
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
LOAEL	Lowest Observed Adverse Effects Level
MCL	Maximum Contaminant Level
MEP	Maximum Extent Practicable
mg/kg	milligrams per kilogram or parts per million (ppm)
NC	North Carolina
NC DENR	North Carolina Department of Environment and Natural Resources
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effects Level
NPL	National Priority List
O&M	Operation and Maintenance
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons
PGC	Prince George Creek
ppb	parts per billion
ppm	parts per million
PRG	EPA Region 9 Preliminary Remediation Goals
RAO	Remedial Action Objectives
RBC	EPA Region 3 Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SESD	EPA Region 4 Science and Ecosystem Support Division
SI	Site Inspection

SQL	Sample Quantification Limit
SVOCs	Semi-Volatile Organic Compounds
TCDD	tetrachlorodibenzodioxin
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxicity Equivalence Quotient
$\mu g/kg$	micrograms per kilogram
$\mu g/L$	micrograms per Liter
US	United States
US FWS	United States Fish and Wildlife Service
VOCs	Volatile Organic Compounds
WESTON	Roy F. Weston, Inc.
yd^3	cubic yards
$<$	less than

PART 1: THE DECLARATION

1.1 Site Name and Location

This Record of Decision (ROD) is for the Reasor Chemical Company Site, which is located at 5100 North College Road, 0.5 miles southeast of the intersection of NC Route 132 and US Route 117 (NC Route 133) in Castle Hayne, New Hanover County, North Carolina. The EPA Site Identification Number is NCD986187094.

1.2 Statement of Basis and Purpose

This decision document presents the Selected Remedy for the Reasor Chemical Company Site (the "Site"), which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for the Site. The State of North Carolina concurs with the Selected Remedy.

1.3 Assessment of Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare and the environment from actual or threatened releases of hazardous substances to the environment.

1.4 Description of Selected Remedy

The overall cleanup strategy for this Site is to reduce the amount of contamination in soils, sediments, surface water and groundwater to protect both human and ecological receptors. The selected remedy removes the source materials constituting principal threats at the site. The major components for the Selected Remedy include:

- ❑ Pumping the approximate 500,000 gallons of contaminated surface water from Ponds 1, 2, 3 and 4 into tanker trucks for off-site treatment and disposal;
- ❑ Excavation and off-site disposal, at a permitted RCRA facility, of the approximate 1,600 cubic yards of contaminated soil and sediment from Ponds 1-4, the scrap copper area, the pipe shop area and the drum disposal area;
- ❑ Backfill and vegetate the excavated areas with native species;
- ❑ Place recordations on property deeds indicating that the groundwater is contaminated with inorganic compounds;
- ❑ Perform annual monitoring of groundwater to determine if contaminants of concern continue to be elevated;
- ❑ If groundwater contaminants of concern continue to be present in concentrations exceeding clean-up standards, a contingency remedy will be implemented.

1.5 Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action (unless justified by a waiver), is cost effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

For surface water, this remedy satisfies the statutory preference for treatment as a principal element of the remedy. For groundwater, the selected remedy does not meet the statutory preference for treatment, but the contingency remedy does. For soil and sediment, the remedy will not satisfy the statutory preference for treatment as a principal element for the following reasons. The relatively small quantity of contaminated soil and sediment does not make on-site treatment cost effective. It is not anticipated that the excavated soils and sediment will contain concentrations of hazardous substances that are elevated enough to be considered Resource Conservation and Recovery Act (RCRA) hazardous wastes. Therefore, after Toxicity Characteristic Leaching Procedure (TCLP) testing is conducted, it is anticipated that the soils and sediments will be disposed of in a RCRA permitted Subtitle D landfill as a regulated "non-hazardous" solid waste.

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, but it will take more than five years to attain remedial action objectives and cleanup levels, a policy review may be conducted within five years of construction completion for the site to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this Record of Decision (Part 2). Additional information can be found in the Administrative Record file for this Site.

- ✔ Chemicals of concern and their respective concentrations (pages 30, 40-42)
- ✔ Baseline risk represented by the chemicals of concern (pages 36 and 37)
- ✔ Cleanup levels established for chemicals of concern and the basis for these levels (page 89)
- ✔ How source materials constituting principal threats are addressed (page 78)
- ✔ Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the Baseline Risk Assessment and ROD (page 29)
- ✔ Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (page 88)
- ✔ Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (pages 85-88)
- ✔ Key factor(s) that led to selecting the remedy (i.e. describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (pages 78-79)

1.7 Authorizing Signatures

26 SEP 02

Richard D. Green, Director
Waste Management Division

Date

PART 2: THE DECISION SUMMARY

2.1 Site Name, Location, and Brief Description

This Record of Decision (ROD) is for the Reasor Chemical Company Site, which is located at 5100 North College Road, 0.5 miles southeast of the intersection of NC Route 132 and US Route 117 (NC Route 133) in Castle Hayne, New Hanover County, North Carolina. The Site's coordinates are latitude 34° 20' 36.5" N and longitude 77° 53' 31" W. The United States Environmental Protection Agency's (EPA) Site Identification Number is NCD986187094. The lead agency for this Site is the EPA. The EPA proposed the Site to the National Priorities List (NPL) on September 13, 2001 (Volume 66, Number 178). The Site was finalized on the NPL on September 5, 2002 (Volume 67, Number 172). The Site remediation is planned to be conducted using Superfund monies.

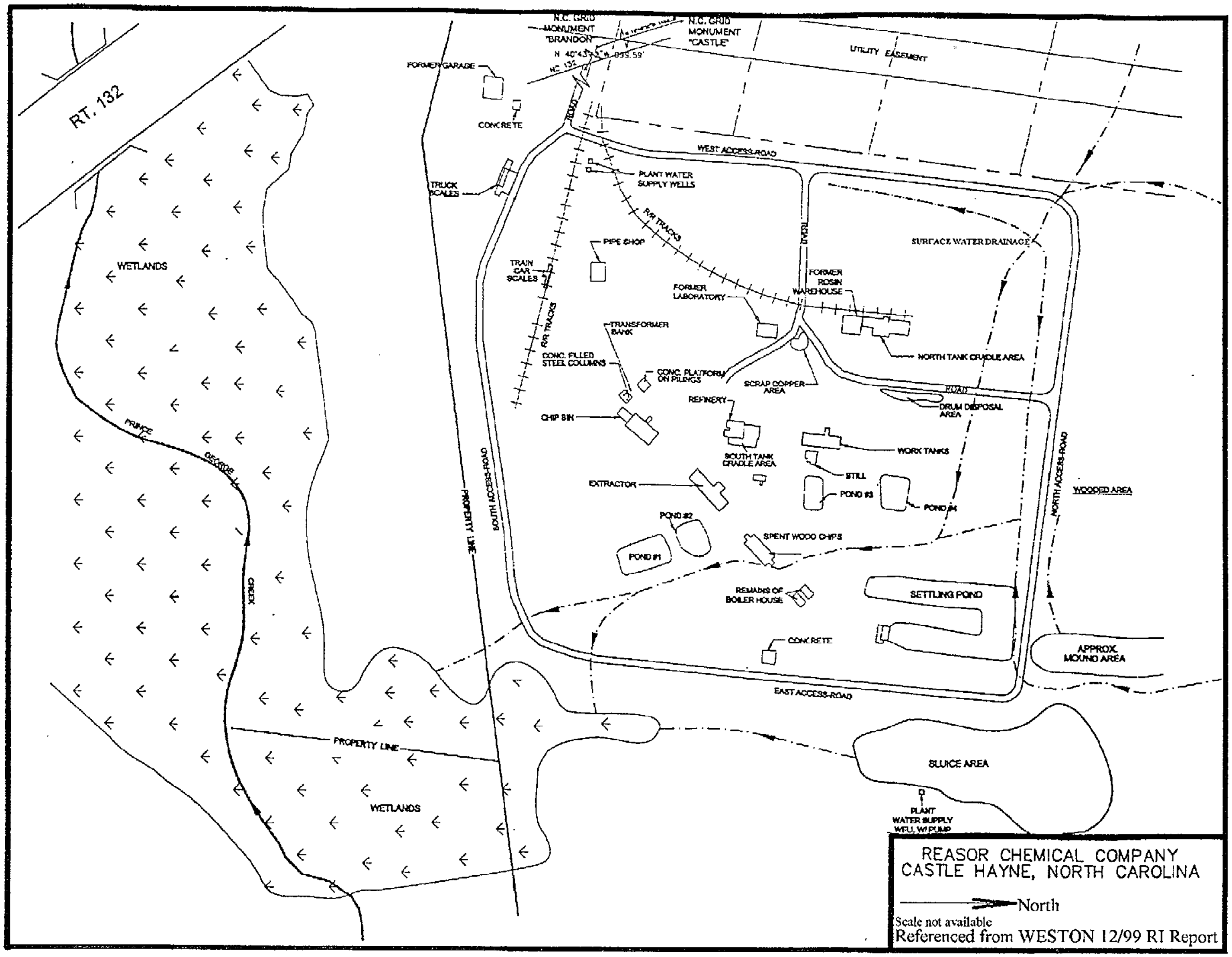
The Site, comprised of approximately 25 acres, is an abandoned stump rendering facility, which operated from 1959 to 1972. The facility produced turpentine, pine resin, pitch, tall oil, pine oil, camphor, pine tar, and charcoal from pine tree stumps. It is believed that the facility used various solvents to extract raw product from chipped stumps distilling the extract into separate product fractions. The solvents used in the extraction process were likely stored on site in 55-gallon drums, the remains of which are located in a surface drum disposal area near the center of the property. A fire and possible explosion occurred on the property on April 7, 1972, which damaged and destroyed the remaining buildings and material on the site property. The property is currently vacant, is overgrown with brush and secondary growth forest, and has unpaved roads running throughout the site. There are a few site features which are still distinguishable which include: three tank cradle areas, a boiler house, concrete slabs from the former rosin warehouse, laboratory, garage, still, process line, transformer area, train scale, and several other unidentified former buildings. Five ponds used in the manufacturing process, a scrap copper area, two railroad sidings, a surface drum disposal area, a sluice area, and several drainage ditches are also still present at the site. (See Figure 1 for Site diagram.)

2.2 Site History and Enforcement Activities

2.2.1 Activities that lead to current problem

It is believed that the facility used various solvents to extract raw product from chipped stumps, distilling the extract into separate product fractions. The solvents used in the extraction process were likely stored on site in 55-gallon drums, the remains of which are located in a surface drum disposal area near the center of the property. It is thought that four of the ponds were used in the manufacturing process. These ponds contain sediments with elevated concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs), and inorganic compounds. An area thought to have been used to scrap copper is also present, which has elevated concentrations of copper and lead.

Figure 1 - Reasor Chemical Company Site Diagram



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2.2.2 Previous Investigations

There have been several environmental investigations that have occurred at the Site. In 1989, Law Environmental, Inc. conducted a Preliminary Environmental/Liability Assessment for a prospective purchaser of the property. In 1991 the Superfund Section of the North Carolina Department of Environment, Health and Natural Resources (now known as the North Carolina Department of Environment and Natural Resources (NC DENR)), conducted a Preliminary Assessment (PA). In 1991, Roy F. Weston, Inc. (WESTON) conducted a site investigation for the Emergency Response and Removal Branch of EPA. In 1995, NC DENR conducted a Site Inspection (SI). During 1996 through 2002, WESTON performed the Remedial Investigation/Feasibility Study for EPA. During 2000 through 2002, EPA's Science and Ecosystem Support Division (SESD) completed the Ecological Risk Assessment.

2.2.2.1 Preliminary Environmental/Liability Assessment, 1989

In 1989, Law Environmental, Inc. conducted a Preliminary Environmental/Liability Assessment. The assessment included surface soil, sediment, and groundwater sampling. All samples were analyzed for acetone, benzene, toluene, and xylenes. Select samples were also analyzed for toxaphene and phenols. The samples were obtained on March 22, 1989.

Surface soil samples were obtained from three locations: North Tank Cradle area, Sluice area, and the Drum Disposal area. Acetone was found in all three samples at concentrations ranging from 108 μg/kg (micrograms per kilogram or parts per billion (ppb)) to 133 μg/kg. Toluene and Xylene were detected in only the North Tank Cradle Area sample at concentrations of 18.2 μg/kg and 92.9 μg/kg, respectively. Phenols and Toxaphene were only analyzed in one sample (Drum Disposal Area) and found at concentrations of 5,120 μg/kg and < 500 μg/kg {Below the laboratory Detection Limit (BDL)}, respectively.

Sediment samples were obtained from four locations: Settling Pond, Pond 2, Pond 3 and Pond 4. Acetone was found in three of the four samples with concentrations ranging from BDL to 5,600 μg/kg (Pond 4). Benzene was detected in three samples with concentrations ranging from BDL to 909 μg/kg (Pond 4). Toluene was detected in three samples with concentrations ranging from BDL to 90,000 μg/kg (Pond 2). Xylene was detected in two of the samples with concentrations ranging from BDL to 25,000 μg/kg (Pond 2). Phenols were only analyzed in three of the samples and had concentrations ranging from 903 μg/kg to 175,000 μg/kg (Pond 3). Toxaphene was only analyzed in one sample (Settling Pond) and the results were BDL.

A groundwater sample was obtained from the observation well located near the southeastern corner of the property. All results were below the Federal Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCL). However, the concentration of benzene (3.6 μg/kg) exceeded the North Carolina Administrative Code, Subchapter 2L MCL value of 1 μg/kg.

2.2.2.2 Preliminary Assessment, 1991

NC DENR conducted a Preliminary Assessment (PA) in 1991 which included a site reconnaissance and a review of aerial photographs and previously collected data. During the site reconnaissance, all features identified in the Law report were identified except for the observation well. A potable well survey identified two wells located at the adjacent APAC asphalt plant. One well was no longer in use and the other well supplied drinking water to 18 workers at the facility.

The PA concluded that soil, sediment and groundwater were contaminated with VOCs and SVOCs, and that the Site contamination resulted from operations during the 1960s and 1970s. Potentially affected targets included neighboring water supply wells, wetlands in Prince George Creek, and a fishery located downstream of the Site.

2.2.2.3 Emergency Response and Removal Branch Site Investigation, 1991

In December 1991, WESTON's Technical Assistance Team conducted a Site Investigation for the Emergency Response and Removal Branch of EPA. They identified the remains of approximately 30 to 40 decaying drums.

2.2.2.4 Site Investigation, 1995

The 1995 NC DENR Site Inspection further characterized the Site. Surface soil, sediment, surface water and groundwater samples were obtained on November 2, 1994, and were analyzed for VOCs and SVOCs and a few samples were analyzed for pesticides.

Surface soil samples were obtained from two locations: Background and Drum Disposal area. Only three SVOCs were detected in the Drum Disposal Area: anthracene (330 μg/kg), fluoranthene (2,083 μg/kg), and phenanthrene (667 μg/kg).

Sediment samples were obtained from four locations: Pond 2, Drainage ditch, Prince George Creek (PGC) south of the Site (PGC-S), and PGC southeast of the Site (PGC-SE). Acetone was detected in PGC-S, at an estimated concentration of 28 μg/kg. Benzene was detected in Pond 2, at a concentration of 135 μg/kg. Ethylbenzene was detected in PGC-S and Pond 2 at trace and 3,288 μg/kg, respectively. Toluene was detected in PGC-S and Pond 2 at 10 μg/kg and 23,458 μg/kg, respectively. Xylenes were detected in PGC-S and Pond 2 at trace and 117,113 μg/kg, respectively.

Surface water samples were obtained from two locations: PGC-S and PGC-SE. No VOCs, SVOCs, nor Pesticides were detected in PGC-SE. Only "trace" concentrations of carbon disulfide, styrene and toluene were in PGC-S.

Groundwater samples were obtained from the three closest off-Site wells: APAC well and two domestic wells located less than ½ mile southwest and southeast of the Site. No VOCs, SVOCs, nor Pesticides were detected.

During the SI, a survey of groundwater use was conducted. No municipal water supply wells or distribution lines were located within 4 miles of the Site. In the 4-mile radius of the Site, approximately 2,608 people received groundwater through domestic individual wells, and approximately 4,238 people received groundwater through the 19 community wells. The nearest community well served approximately 50 people and was located at Shady Haven Mobile Home Park, which is 1,500 to 2,500-feet southwest of the site. The Prince George Estates community well served approximately 600 people and was located 3,000 feet southwest of the Site. Sample data obtained from the new Hanover County Engineering Department for June of 1994 for the Prince George Estates community well showed the following detected in groundwater: Chloroform (17 micrograms per Liter (μg/L or ppb)), Bromoform (0.75 μg/L), Bromodichloromethane (10.9 μg/L), and chlorodibromoethane (8.44 μg/L).

The SI concluded that pine tar and hardened resins at the Site might be sources for VOCs, SVOCs, and potentially toxaphene. NC DENR recommended that further action be conducted under CERCLA/SARA, specifically, an Expanded Site Inspection (ESI) with a low priority rating, based on the following:

- No VOCs were detected in the closest water supply wells.
- The only contaminants detected in Prince George Creek sediments that were attributable to the Site were acetone and toluene.
- The impact of soil contamination and air emissions on the local population or environment would be minimal based on the limited target population and nature of the waste.

2.2.2.5 Remedial Investigation, 1996-1999

Based on the information available, EPA decided to save time and money by skipping the ESI portion of the Superfund process. Through a work assignment with EPA, WESTON began the Remedial Investigation (RI) in August of 1996 and completed it in December 1999. The purpose of the RI was to characterize the extent of contamination and to assess potential contaminant migration pathways. The results confirmed contamination present in several areas of the site. The results are listed in detail in Section 2.5.6 of this ROD.

2.2.2.6 Ecological Risk Assessment, 1999-2002

The Screening Level Ecological Risk Assessment was submitted by WESTON in December 1999 under the RI/FS Work Assignment. This document indicated that the ecological risk assessment needed to proceed to at least Step 3 of the Ecological Risk Assessment (ERA) Process. In February 2000, the remainder of the ERA was tasked to EPA Region 4's SESD. In September 2000, personnel from EPA-SESD, EPA Region 4's Office of Technical Services (EPA-

OTS), National Oceanic and Atmospheric Administration (NOAA) and the United States Fish and Wildlife Service (US FWS) performed a Site visit. In December 2001, EPA-SESD, EPA-OTS and the Remedial Project Manager (RPM) visited the site and obtained surface soil, sediment and surface water samples for toxicity testing, bioaccumulation testing, and analysis. In July 2002, EPA-SESD submitted the Final Report, Field Investigation Report and Ecological Risk Characterization, which concluded that surface soils and sediments had concentrations of hazardous substances that were toxic to ecological receptors. This is discussed in more detail in Section 2.7.2.

2.2.3 Enforcement Activities

In 1996, an initial Potentially Responsible Party (PRP) search was conducted. In 1996 and 1997, EPA sent 104(e) Information Request letters to several parties. In November 2001, a follow-up was conducted. While some of the PRPs identified appear no longer viable, EPA continues to investigate the viability of several PRPs.

2.3 Community Participation

A Fact Sheet was distributed to the community in March 1997, announcing the beginning of the Fund-lead Remedial Investigation and Feasibility Study. A Community Relations Plan was prepared in July 1997. A "Kick Off" Public Meeting was also conducted in Castle Hayne, NC in 1997. Fact Sheet Updates were distributed to the community in September 1998 and May 2000, providing the status of the investigation.

The Proposed Plan Fact Sheet was mailed to the community on July 11, 2002. The Administrative Record file was made available to the public on July 19, 2002. It was placed in the information repository maintained at the EPA Region 4 Superfund Record Center and at the New Hanover County Public Library. The notice of the availability of the Administrative Record and an announcement of the Proposed Plan public meeting was published in the Wilmington Morning Star on July 17, 2002. A public comment period was held from July 19, 2002 to August 18, 2002. The Proposed Plan was presented to the community in a public meeting on July 30, 2002 at the Castle Hayne Volunteer Fire Station. At this meeting, representatives from EPA and NC DENR answered questions about problems at the site and the remedial alternatives. EPA also used this meeting to solicit community input on the reasonably anticipated future land use at the site. EPA's response to the comments received during this period is included in the Responsiveness Summary, located in Part 3 of this ROD. The transcript from the meeting can be found in the Administrative Record.

2.4 Scope and Role of Operable Unit or Response Action

EPA has chosen to use only one Operable Unit for this Site. The remedy will remove soil, sediment and surface water contaminated with elevated levels of VOCs, SVOCs (primarily PAHs), and Inorganic compounds. The removal and treatment methods vary depending on the media, and can be found in Section 2.12 of this ROD. This action will reduce the risks to human and ecological receptors.

The remedy will place notices on the property deed(s) describing potential groundwater contamination. It will also provide for better characterization of the Site groundwater to determine if groundwater is truly contaminated. If groundwater is later determined to be contaminated, the contingency remedy, groundwater treatment using Constructed Wetlands, will be invoked.

2.5 Site Characteristics

2.5.1 Conceptual Site Model

The Conceptual Site Model developed in the Baseline Human Health Risk Assessment (BHHRA) is presented in Table 1.

Table 1 - Conceptual Site Model (Human Receptors)

Scenario	Receptor	Exposure Pathway(s)	Exposure Routes
EPS-1 Current Use	Trespasser	Surface Soil (0-1 feet)	Incidental Ingestion
			Dermal Contact
			Inhalation of Particulates
			Inhalation of Volatiles
		Surface Water (Drainages)	Dermal Contact
		Surface Water (Ponds)	Dermal Contact
EPS-2 Future Use	Child and Adult Resident	Surface Soil	Incidental Ingestion
			Dermal Contact
			Inhalation of Particulates
			Inhalation of Volatiles
		Groundwater	Ingestion
			Non-ingestion Uses (inhalation of volatiles from household uses and dermal contact while showering)
		Surface Water (Drainages)	Dermal Contact
		Surface Water (Ponds)	Dermal Contact
EPS-3 Future Use	Industrial Worker	Surface Soil	Incidental Ingestion
			Dermal Contact
			Inhalation of Particulates
			Inhalation of Volatiles
		Groundwater	Ingestion
			Dermal Contact while showering
			Inhalation of volatiles while showering
		Surface Water (Drainages)	Dermal Contact
		Surface Water (Ponds)	Dermal Contact
EPS-4 Future Use	Construction Worker	Surface Soil	Incidental Ingestion
			Dermal Contact
			Inhalation of Particulates
			Inhalation of Volatiles

Notes:
EPS = Exposure Pathway Scenario

The Conceptual Site Model developed in the Ecological Risk Assessment is presented in Table 2.

Table 2 - Conceptual Site Model (Ecological Receptors)

Primary Source	Primary Release Mechanism	Affected Media	Secondary Release Mechanism	Affected Media	Exposure Route	Terrestrial Receptor	Aquatic Receptor
Historical Process Operations	Leaks/Drips/ Spills	Soil	Soil	Soil	Ingestion	✔	
					Dermal	✧	
					Inhalation	✧	
					Prey	✔	
			Runoff	Surface Water	Ingestion	✔	✔
					Dermal	✧	✔
					Inhalation	✧	✔
					Prey	✔	✔
			Surface Runoff	Sediment	Ingestion	✔	✔
					Dermal	✧	✔
					Inhalation	✧	✔
					Prey	✔	✔
	Wastewater Discharge	Ditches/Drains		Surface Water	Ingestion	✔	✔
					Dermal	✧	✔
					Inhalation	✧	✔
					Prey	✔	✔
				Sediment	Ingestion	✔	✔
					Dermal	✧	✔
					Inhalation	✧	✔
					Prey	✔	✔

Notes:
✔ Indicates pathways that were evaluated in the Ecological Risk Assessment
✧ Indicates potential pathways that were not evaluated in the Ecological Risk Assessment

2.5.2 Site Overview

The Site comprises approximately 25 acres. It is currently vacant and overgrown with vegetation and secondary growth forest. The southern border of the Site approaches wetlands which surround Prince George Creek. Several drainage ditches are present throughout the Site, which ultimately flow to Prince George Creek.

2.5.3 Surface and Subsurface Features

During the RI, the Site was broken down into the following 20 areas: Wood Chip Processing, Rosin Warehouse, North Tank Cradle, Work Tanks, South Tank Cradle, Laboratory, Garage, Still, Transformer, Pipe Shop, U-Shaped Settling Pond, Pond 1, Pond 2, Pond 3, Pond 4, Drum Disposal, Refinery Building, Piping System, Sluice, and Scrap Copper Area. Of those, only the following areas were determined to contain concentrations of chemicals above the clean-up goals established in later sections of this ROD: Scrap Copper Area, Drum Disposal Area, Pipe Shop Area, Pond 1, Pond 2, Pond 3 and Pond 4.

2.5.4 Sampling Strategy

During the Remedial Investigation the following media were sampled: surface soil, subsurface soil, sediment, surface water and groundwater. Over one hundred locations were sampled during the years of 1997, 1998 and 1999. The samples were analyzed for VOCs, SVOCs, Pesticides, PCBs, Metals, and Dioxins/Furans. During the Ecological Risk Assessment, 7 surface soil, 8 sediment and 6 surface water samples were obtained in December 2001. Those samples were analyzed for VOCs, SVOCs, Metals, and Dioxins/Furans.

2.5.5 Known and/or Suspected Sources of Contamination

Suspected sources of contamination include solvents utilized in the manufacturing process. It appears that wastes were deposited into four of the on-site ponds/surface impoundments. Another source of contamination is from scrap copper processing on a small portion of the Site.

2.5.6 Types of Contamination and Affected Media

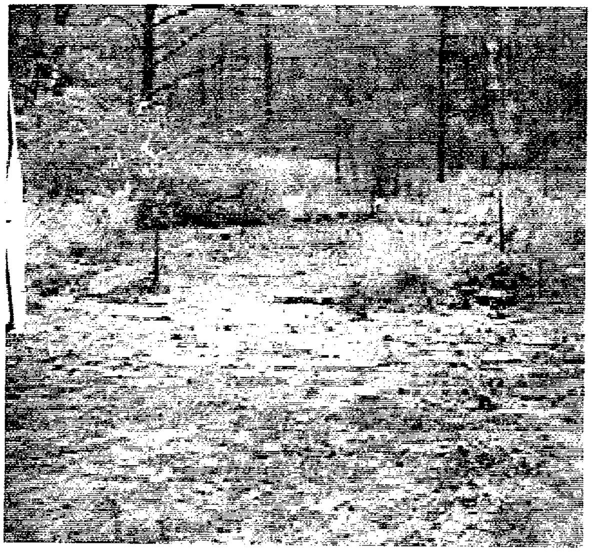
2.5.6.1 Surface Soil

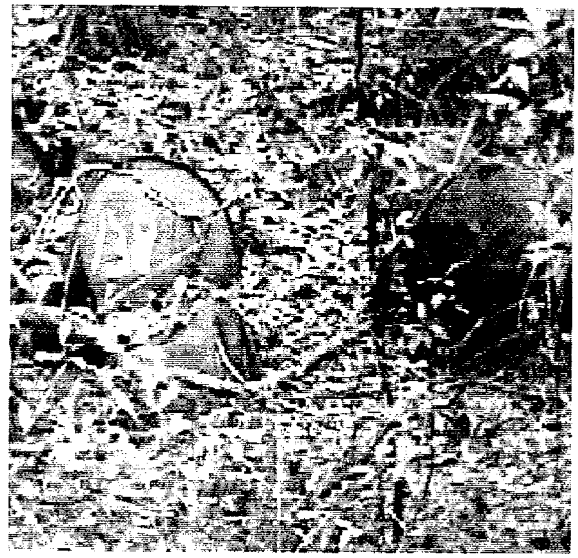
During the RI, surface soil samples were obtained from 105 locations in August 1997 and May 1999. The samples were obtained from 0-12 inches below the surface. Of the 105 sample locations, 102 were analyzed for VOCs and SVOCs, 23 were analyzed for metals, 14 were analyzed for pesticides/PCBs, and 8 were analyzed for dioxin/furans.

In December 2001, during the Ecological Risk Assessment process, seven surface soil samples were obtained. They were analyzed for VOCs, SVOCs, Metals and Dioxins/Furans. The results indicated higher concentrations of metals than what was previously found in the Scrap Copper Area.

Because of the volume of samples, the most significant results are broken down into two tables. The tables include the following Contaminants of Potential Concern (COPCs): benzo(a)anthracene (maximum concentration: 6,000 μg/kg), benzo(a)pyrene (maximum concentration: 9,500J μg/kg), benzo(b &/or k)fluoranthene (maximum concentration: 11,800J μg/kg), dibenzo(a,h)anthracene (maximum concentration: 930J μg/kg), ideno(1,2,3-cd)pyrene (maximum concentration: 2,500J μg/kg), antimony (maximum concentration: 370 mg/kg), arsenic (maximum concentration: 10 mg/kg), copper (maximum concentration: 99,000 mg/kg), lead (maximum concentration: 2,100 mg/kg), 2,3,7,8-tetrachlorodibenzodioxin (maximum concentration: 18 ng/kg), dioxin Toxicity Equivalent Quotient (TEQ) (maximum concentration: 910 ng/kg). They were found in the following nine Site areas at concentrations exceeding screening levels: scrap copper area, drum disposal area, pipe shop area, sluice area, refinery, still, work tanks area, wood chip processing area, and transformer bank area.

The samples with results greater than $1x10^{-6}$ carcinogenic risk level and non-carcinogenic risk greater than a Hazard Quotient (HQ) of 0.1 from the Baseline Human Health Risk Assessment and values greater than those thought to be protective of ecological receptors according to the Ecological Risk Assessment are included in the following two tables. Table 3 presents the samples with concentrations that exceed the clean-up goals for at least one contaminant. Table 4 presents the samples with concentrations that exceed the $1x10^{-6}$ and HQ=0.1 values, but are less than the clean-up value.





December 11, 2001 - Reasor Chemical Company Site

Photo #1 - Scrap Copper Area

Photo #2 - Drum Disposal Area

Table 3 - Surface Soil Analytical Results That Exceed Clean-up Goals

Sample ID:	$1x10^{-6}$, HQ=0.1 concen-tration	Clean-up value	Note	SS-11	SS-13	SS-14	RC111SS	SS-23	SS-26	RC126SS	SS-85
Sample Area:				Scrap Copper Area				Drum Disposal Area			Pipe Shop
SVOCs (μg/kg)	$1x10^{-6}$	$1x10^{-5}$									
Benzo(a)anthracene	610	6100	1	–	4000	–	2200J	1200 J	4400	6000	–
Benzo-a-pyrene	61	610	1	**620**	**3100**	–	**2500J**	**850 J**	**3900**	**9500J**	160 J
Benzo(b&/or k)fluoranthene	610	6100	1	–	4000J	–	1980J	1,300J	5300J	**11,800J**	–
Dibenzo(a,h)anthracene	61	610	1	–	–	–	330J	–	–	**930J**	–
Ideno (1,2,3-cd)pyrene	610	6100	1	–	1400J	–	780J	–	2100 J	2500J	–
METALS (mg/kg)	HQ=0.1										
Antimony	3	30	2	--	–	–	370	NA	NA	3.7	**67 J**
Arsenic	2.2	22	2	--	–	–	--	NA	NA	--	10
Copper	280	2700	3	**3400 J**	**5900 J**	**4900 J**	**99,000**	NA	NA	--	**3400**
Lead	--	400	4	–	–	–	**2,100**	NA	NA	--	**410**
DIOXINS (ng/kg)	$1x10^{-6}$										
2,3,7,8-TCDD	3.9		5	--	--	--	18	NA	NA	--	NA
TEQ		1000	4	15 J	–	–	910	NA	NA	20	NA

Notes:
1. Clean-up goal is value for carcinogenic risk of $1x10^{-5}$.
2. Clean-up goal is value for non-carcinogenic Hazard Quotient = 1.
3. Clean-up goal is the highest concentration in a sample that did not exhibit toxicity in the Ecological Risk Assessment.
4. Clean-up goal is EPA's guidance on lead and dioxin clean-up values for residential properties. Lead was not identified as a COPC in the BHHRA.
5. Value is for 2,3,7,8-TCDD from the BHHRA. 2,3,7,8-TCDD was not detected on-site, except for sample RC111SS at 18 ng/kg.

– Concentration detected was less than the $1x10^{-6}$ or HQ=0.1 value.
J = estimated concentration
NA = Not analyzed
TCDD = tetrachlorodibenzodioxin
TEQ = Toxicity Equivaltent Quotient
Concentrations in Bold font exceed the Clean-up goal for the analyte in bold font.

Table 4 - Surface Soil Analytical Results That Are Greater than $1x10^{-6}$ and HQ=0.1 Concentrations but Less than Clean-up Goals

Sample ID:	$1x10^{-6}$, HQ=0.1 concen-tration	Clean-up value	Note	SS-8	RC112 SS	SS-21	SS-42	SS-45	SS-48	SS-52	SS-56	SS-64	SS-65	SS-79	SS-82	RC185 SS
Sample Area:				Sluice Area	Scrap Copper Area	Drum Disposal Area	Re-finery	Still	Work Tanks		Wood Chip Processing			Transformer Bank		Pipe Shop
SVOCs (μg/kg)	$1x10^{-6}$	$1x10^{-5}$														
Benzo(a)anthracene	610	6100	1	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo-a-pyrene	61	610	1	130 J	--	120 J	–	86J	160 J	110 J	310 J	110 J	160 J	320 J	120 J	340 J
Benzo(b&/or k)fluoranthene	610	6100	1	–	–	–	1200 J	--	–	–	–	–	–	–	–	–
Dibenzo(a,h)anthracene	61	610	1	–	–	–	–	--	–	–	–	–	–	110 J	360 J	–
Ideno (1,2,3-cd)pyrene	610	6100	1	--	--	--	--	--	--	--	--	--	--	--	--	--
METALS (mg/kg)	HQ=0.1															
Antimony	3	30	2	NA	12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--
Arsenic	2.2	22	2	NA	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--
Copper	280	2700	3	NA	2700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	640
Lead	--	400	4	NA	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--
DIOXINS (ng/kg)	$1x10^{-6}$															
2,3,7,8-TCDD	3.9		5	NA	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--
TEQ (Toxic Equiv. Value)		1000	4	NA	48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--

Notes:
1. Clean-up goal is value for carciriogenic risk of 1x10-5.
2. Clean-up goal is value for non-carcinogenic Hazard Quotient = 1.
3. Clean-up goal is the highest concentration in a sample that did not exhibit toxicity in the Ecological Risk Assessment.
4. Clean-up goal is EPA's guidance on lead and dioxin clean-up values for residential properties. Lead was not identified as a COPC in the BHHRA.
5. Value is for 2,3,7,8-TCDD from the BHHRA. 2,3,7,8-TCDD was not detected on-site, except for sample RC111SS at 18 ng/kg.

-- Concentration detected was less than the $1x10^{-6}$ or HQ=0.1 value.
J = estimated value
NA = Not analyzed
TCDD = tetrachlorodibenzodioxin
TEQ = Toxicity Equivalent Quotient

2.5.6.2 Subsurface Soil

During the RI, 35 subsurface soil samples were obtained in August 1997 and May 1999. The samples were obtained from the vadose zone, typically 4- to 8-feet below ground surface. Of the 35 sample locations, 32 were analyzed for VOCs, 34 were analyzed for SVOCs, all 35 were analyzed for metals, 6 were analyzed for pesticides/PCBs, and 5 were analyzed dioxin. Only two samples had results greater than $1x10^{-6}$ carcinogenic risk level, and non-carcinogenic risk greater than HQ=0.1 from the Baseline Human Health Risk Assessment. The three COPCs in those samples were benzo(a)pyrene (maximum concentration: 240J μg/kg), benzo(b &/or k)fluoranthene (maximum concentration: 1,000 μg/kg), and copper (maximum concentration: 593J mg/kg). All results were below the clean-up values that are established in section 2.12.4.2 of this ROD.

Table 5 - Subsurface Soil Analytical Results That Are Greater than $1x10^{-6}$ and HQ=0.1

Sample ID:	$1x10^{-6}$, HQ=0.1 concentration	Clean-up Goal	Note	GP-2	SU-02
Sample Depth (feet):				0-4	2-3
Sample Area:				SW Border	Scrap Copper Area
SVOCs (µg/kg)	$1x10^{-6}$	$1x10^{-5}$			
Benzo-a-pyrene	61	610	1	240 J	--
Benzo(b&/ork)fluoranthene	610	6100	1	1000	--
METALS (mg/kg)	HQ=0.1				
Copper	280	2700	2	--	593J

Notes:
1. Clean-up goal is value for carcinogenic risk of 1x10-5.
2. Clean-up goal is the highest concentration in a sample that did not exhibit toxicity in the Ecological Risk Assessment.
- Concentration detected was less than the $1x10^{-6}$ or HQ=0.1 value.
J = estimated value

2.5.6.3 Sediment

During the RI, a total of 32 sediment samples were obtained during three separate sampling events in August 1997, August 1998 and May 1999. The samples were obtained from on-site ponds, on- and off-site drainage ditches, small streams, creeks, and swamps. Of the 32 samples, 28 were analyzed for VOCs and SVOCs, 11 were analyzed for metals, 7 were analyzed for pesticides/PCBs, and 13 were analyzed dioxin.

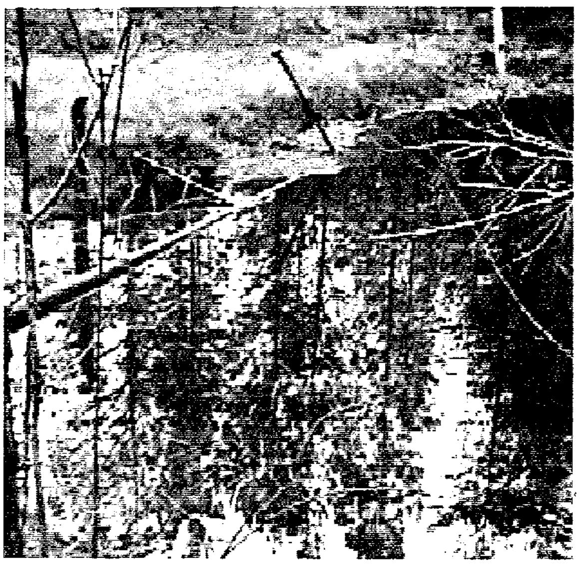
In December 2001, during the Ecological Risk Assessment process, seven sediment samples were obtained from the Ponds, Prince George Creek and one background location. The samples were analyzed for VOCs, SVOCs, metals and dioxins/furans.

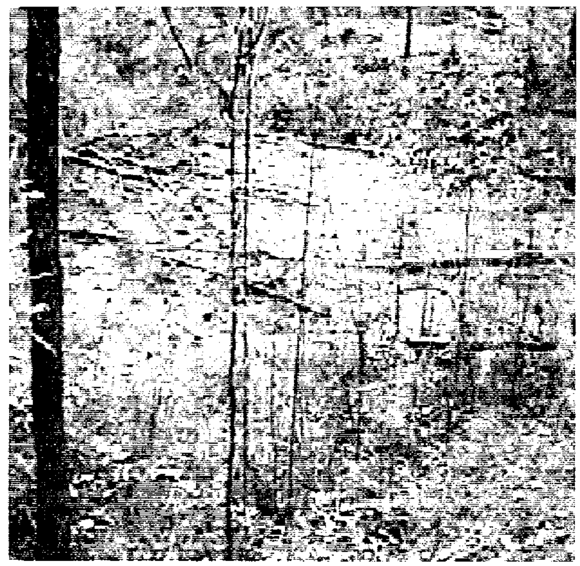
Sediment was not considered as a pathway/media of concern in the BHHRA. Four contaminants were present on-site at concentrations exceeding the Baseline Ecological Risk Assessment's Alternative Toxicity Values (ATV): toluene (maximum concentration: 500,000 µg/kg), (3 &/or 4)-methylphenol (maximum concentration: 56,000J µg/kg), total PAHs (maximum concentration: 218,690 µg/kg) and copper (maximum concentration: 920 mg/kg). The Site areas with contaminant concentrations exceeding ATVs were Pond 2, Pond 3, Pond 4, the Drum Disposal Area, and the Southwest Wetland. A summary of the sediment results exceeding ATVs are presented in Table 6.

Table 6 - Sediment Samples with Results Greater than ATVs

Sample ID:		SE-02	SE-03	SE-12	SE-25	RC103SS	SE-04	SE-10	RC104SS	SE-9	SE-21
Sample Area:	ATV	Pond 2	Pond 3				Pond 4			Drum Disp	SW Wetland
VOCs (µg/kg)											
Toluene	8,050	NA	NA	7,600	29,000	29,000	NA	500,000	--	--	--
SVOCs (µg/kg)											
(3 and/or 4)-Methylphenol	50	NA	NA	8,300	--	56,000J	NA	10,000J	4,600J	--	94J
Total PAHs	13,660	NA	NA	--	--	218,690	NA	--	25,630	85,600	--
METALS (mg/kg)											
Copper	197	208J	245J	NA	NA	920	655J	NA	770	NA	NA

Notes:
ATV = Alternate Toxicity Value
J = estimated value
NA = Not Analyzed
-- = results below ATV





December 11, 2001 - Reasor Chemical Company Site
Photo #3 - Pond 2 Photo #4 - Pond 3

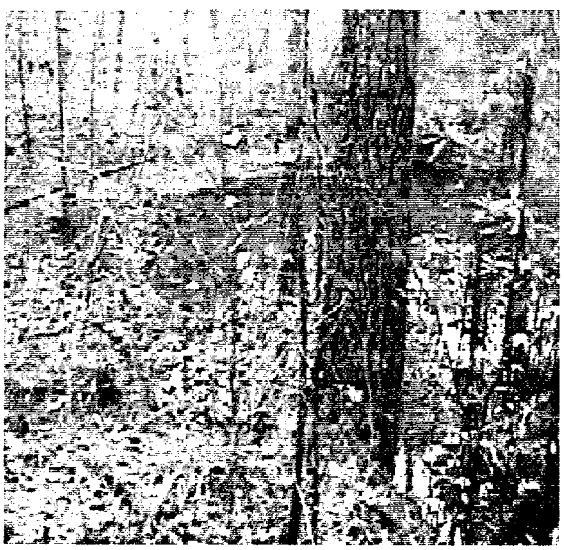
2.5.6.4 Surface Water

During the RI, surface water samples were obtained from 19 sample locations during three separate sampling events which occurred in August 1997, December 1997 and May 1998. The samples were obtained from on-site ponds, on- and off-site drainage ditches, and Prince George Creek. Of the 19 sample locations, 18 were analyzed for VOCs, 19 were analyzed for SVOCs, and 10 were analyzed for metals, pesticides/PCBs, and dioxins/furans.

During the Ecological Risk Assessment process, six surface water samples were obtained in December 2001. These samples were analyzed for VOCs, SVOCs, metals and dioxins/furans.

Two samples had concentrations of toluene (maximum concentration: 23 µg/L) which exceeded State of North Carolina Surface Water Standards (NC SWS) but were below the National Recommended Water Quality Criteria for Priority and Non-Priority Toxic Pollutants, Freshwater Criterion Continuous Concentration (NRWQC). One sample had concentrations of fluoranthene and phenanthrene (maximum concentrations: 2J and 3J µg/L respectively) which exceeded the NC SWS but were below the NRWQC. One sample had concentrations of the pesticides heptachlor and alpha-chlordane (maximum concentrations: 0.0095J and 0.019J µg/L respectively) which exceeded the NC SWS, but these were in an upgradient sample. Numerous samples had concentrations of the following metals which exceeded NC SWS and/or NRWQC standards: aluminum (maximum concentration: 4,900 µg/L), copper (maximum concentration: 110 µg/L), iron (maximum concentration: 13,000 µg/L), lead (maximum concentration: 35 µg/L), silver (maximum concentration: 44 µg/L) and zinc (maximum concentration: 95 µg/L).

Samples exceeding NC SWS or NRWQC are in the following two tables. The results from the 1997 and 1998 sampling are in Table 7. The results from the 2001 sampling are presented in Table 8.



December 11, 2001 - Reasor Chemical Company Site

Photo #5 - Pond 1

Photo #6 - U-shaped Settling Pond / Makeshift Road Sign

Table 7 - 1997 and 1998 Surface Water Analytical Results Exceeding Water Quality Standards

Sample ID:			SW-1	SW-2	SW-3	SW-4	SW-10	SW-13	SW-15	SW-18	SW-19	SW-20	SW-21
Sample Area:			Northwest Upgradient		Northeast Upgradient		Pond 3	SE Corner	Sluice & Ditch	East PGC	SE PGC	South PGC	SW PGC
	SWS[1]	WQC[2]											
VOCs (µg/L)													
Toluene	0.36	6,800[A]	--	--	--	--	23	--	--	--	--	NA	--
SVOCs (µg/L)													
Fluoranthene	0.031[B]	1,300[A]	--	--	--	--	2 J	--	--	--	--	--	--
Phenanthrene	0.031[B]	NL	--	--	--	--	3 J	--	--	--	--	--	--
METALS (µg/L)													
Aluminum	NL	87**	990 J	880 J	--	--	NA	2,200 J	690	4,900	480	998	451
Copper	7*	9.0	33	31	30	28	NA	110	--	--	--	--	--
Iron	1,000*	1,000	--	--	--	--	NA	8,800	11,000	13,000	-	3,690	1,060
Lead	3.1	2.5	4	4	--	--	NA	13	--	9	--	--	--
Silver	0.06*	3.4***	31	18	11	12	NA	44	--	--	--	--	--
Zinc	50*	120	--	--	--	--	NA	95	--	--	--	--	--
PESTICIDES (µg/L)													
Heptachlor	0.004	0.0038	--	--	--	0.0095 J	NA	--	--	--	--	--	--
Alpha-Chlordane	0.004	0.0043	--	--	--	0.019 J	NA	--	--	--	--	--	--
DIOXIN (ng/L)													
2,3,7,8-TCDD	.000014	.000013[A]	--	--	--	--	NA	--	--	--	--	--	--
TEQ	NL	NL	--	--	--	--	NA	--	0.00005	0.0004 J	--	--	--

Notes:
1 North Carolina Surface Water Standards
2 National Recommended Water Quality Criteria for Priority and Non-Priority Toxic Pollutants, Freshwater Criterion Continuous Concentration
A human health for consumption of water plus organism
B polynuclear aromatic hydrocarbons (surface waters) to protect human health from carcinogens through consumption of fish only
* Numerical ambient surface water quality standard
** EPA is aware of field data indicating that many high quality waters in the US contain more than 87 µg aluminum/L, when either total recoverable or dissolved measured
*** Criteria Maximum Concentration
-- means result is below surface water criteria
J = estimated value
NA = Not Applicable
NL = Not Listed
PGC = Prince George Creek
TCDD = tetrachlorodibenzodioxin
TEQ = Toxicity Equivalent Quotient

5 9 0027

Table 8 - December 2001 Surface Water Data Exceeding Water Quality Standards

		Sample ID:	RC105SW	RC101SW	RC102SW	RC121SW	RC122SW	RC222SW (Dupl)	RC123SW
		Sample Area:	Bkgd	Pond 1	Pond 2	PGC			
	SWS[1]	WQC[2]							
VOCs (μg/L)									
Toluene	0.36	6,800[A]	--	--	4	--	--	--	--
METALS (μg/L)									
Aluminum	NL	87**	680J	240J	280J	310J	280J	130J	140
Copper	7*	9.0	--	61J	--	40J	--	--	--
Iron	1,000*	1,000	--	6900	4800	--	1600	1800	3500
Lead †	3.1	2.5	18	35	8.6	18	12	15	13
Zinc	50*	120	50	61	--	51	--	--	--
DIOXIN (μg/L)									
2,3,7,8-TCDD	.000014	.000013[A]	--	--	--	--	--	--	--
TEQ	NL	NL	0.0015	--	--	--	--	--	--

Notes:
1 North Carolina Surface Water Standards
2 National Recommended Water Quality Criteria for Priority and Non-Priority Toxic Pollutants, freshwater Criterion Continuous Concentration
A human health for consumption of water plus organism
B polynuclear aromatic hydrocarbons (surface waters) to protect human health from carcinogens through consumption of fish only,
* Numerical ambient surface water quality standard
** EPA is aware of field data indicating that many high quality waters in the US contain more than 87 μg aluminum/L, when either total recoverable or dissolved measured
-- means result is below surface water criteria
† Lead was also detected in the trip blank at 4.4 μg/kg
Bkgd = Background
Dupl = Duplicate
NL = Not Listed
PGC = Prince George Creek
TCDD = tetrachlorodibenzodioxin
TEQ = Toxicity Equivalent Quotient

2.5.6.5 Groundwater

During the RI, groundwater samples were obtained from temporary wells installed on-site during two separate times, pre-existing on-site production wells, permanent monitor wells installed during the RI, residential wells, and community wells.

2.5.6.5.1 Temporary Wells

In August through September 1997, 36 groundwater samples were obtained from temporary wells installed as a part of the RI. Of the 36 sample locations, 36 were analyzed for VOCs, 30 were analyzed for SVOCs, 32 were analyzed for metals, 8 were analyzed for pesticides/PCBs, and 8 were analyzed dioxins/furans.

Of these samples, only two exceeded either the North Carolina Administrative Code, Subchapter 2L, Maximum Contaminant Level or the Federal Safe Drinking Water Act Maximum Contaminant Level (MCLs) for VOCs. The two exceedances were estimated concentrations of 2 μg/L of Benzene in the wells located in the Sill and Pipeline areas. The state MCL for benzene is 1 μg/L, whereas the federal MCL is 5 μg/L. These exceedances were found in wells GPW-13 and GPW-15, which were both sampled at a groundwater depth of 11.5 feet.

Of the 8 samples analyzed for dioxins/furans, 4 samples (including 2 background) had dioxin Toxicity Equivalent Quotient (TEQ) concentrations greater than the 2,3,7,8-Tetrachlorodibenzodioxin (TCDD) MCLs. The highest concentration was found in one of the background samples.

There were no exceedances of MCLs for SVOCs nor pesticides/PCBs.

All 32 samples analyzed for metals exceeded MCLs or Federal Safe Drinking Water Act Secondary MCLs (SMCLs) for at least one metal, including the 4 background samples. The metals exceeding MCLs/SMCLs were aluminum, arsenic, beryllium, cadmium, chromium, iron, lead, nickel, manganese, and thallium. Because of the elevated inorganic concentrations in all temporary wells, including upgradient ones, and the lack of turbidity data, it was thought that the elevated concentrations may have been a result of turbid samples. Therefore, additional temporary well sampling occurred in May 1999.

Table 9 - 1997 Temporary Well Groundwater Results Exceeding MCLs (not including metals)

Sample ID:			GPW-4	GPW-4	GPW-13	GPW-15	GPW-28	GPW-28
Depth Collected (feet):			7.5	23	11.5	11.5	12	17
Sample Area:			Northwest Upgradient (bkg)		Still	Pipeline	Southern Border	
	MCL[1]	MCL[2]						
VOCs (μg/L)								
Benzene	1	5	--	--	2 J	2 J	--	--
METALS (ug/L)								
NUMEROUS EXCEEDED MCLS BUT ARE NOT INCLUDED IN THIS TABLE[3]								
DIOXINS (ng/L)								
2,3,7,8-TCDD	0.00022	0.03	--	--	NA	NA	--	--
TEQ	NL	NL	0.0004J	0.095J	NA	NA	0.004J	0.001J

Notes:
1 North Carolina Administrative Code, Subchapter 2L, Maximum Contaminant Level
2 Federal Safe Drinking Water Act Maximum Contaminant Level
3 At least one inorganic exceeded MCLs for each sample analyzed, but due to questions regarding turbidity, the data isn't presented in this table. Inorganic results from temporary wells sampled in 1999 are reported in Table 10.
bkg = background
J = estimated value
NA = Not Analyzed
NL = Not Listed
TCDD = tetrachlorodibenzodioxin
TEQ = Toxicity Equivalent Quotient
-- means sampled analyzed, but result was below MCL.

In May 1999, groundwater samples were obtained from 10 temporary wells installed as part of the RI. An attempt was made to reduce the amount of turbidity in the samples. Of the ten locations, 2 were analyzed for VOCs and SVOCs, 10 were analyzed for metals, and 4 were analyzed for dioxins/furans.

Of these samples, all ten had at least one metal concentration above MCLs/SMCLs. The metals exceeding MCLs/SMCLs were aluminum, beryllium, iron, lead, manganese and thallium. One of the four samples analyzed for dioxins/furans had a dioxin TEQ concentration which exceeded the 2,3,7,8-TCDD MCL. Neither of the two samples analyzed for VOCs and SVOCs, located in the scrap copper area and drum disposal area, exceeded MCLs.

Table 10 - 1999 Temporary Well Groundwater Results Exceeding MCLs

		Sample ID:	TMW-1	TMW-2	TMW-3	TMW-4	TMW-5	TMW-6	TMW-7	TMW-8	TMW-9	TMW-10
		Depth Collected (feet):	15	18	17	16	18	16	18	18.5	19	16
		Sample Area:	NW Upgradient	W Boundary	SW Corner	Sluice	S Border	Pipe Shop	Scrap Copper	Drum Disp.	Pond 4	Chip Proc.
	MCL[1]	MCL[2]										
TURBIDITY (NTU):			1.11	8.23	1084	5.32	41.9	71.3	8.29	6.12	8.8	9.8
METALS (µg/L)												
Aluminum	NL	50-200*	622	202	14,000	--	638	15,100	229	20,600	299	348
Beryllium	NL	4	--	--	--	--	--	--	--	4.6B	--	--
Iron	300	300*	1870	3680	6510	1800	11,200	4760	3810	51,600	1400	3170
Lead	15	15**	--	--	18.4	--	--	--	--	--	--	--
Manganese	50	50*	144	103	181	--	79.5	90.7	93.5	532	68.5	89.1
Thallium	NL	2	2.8B	--	2.5B	--	4.8B	--	--	8.4B	--	--
DIOXINS (ng/L)												
2,3,7,8-TCDD	0.00022	0.03	--	NA	NA	NA	--	NA	--	--	NA	NA
TEQ	NL	NL	--	NA	NA	NA	0.0013	NA	--	--	NA	NA

Notes:
1 North Carolina Administrative Code, Subchapter 2L, Maximum Contaminant Level (MCL)
2 Federal Safe Drinking Water Act MCL
* Secondary MCL - These values are based on aesthetics rather than health effects and are not used by EPA as clean-up goals for Superfund sites.
** in more than 10% of tap water samples
B = analyte analyzed and value obtained from reading less than Contract Required Detection Limit but greater than or equal to Instrument Detection Limit
Disp. = Disposal
NA = Not Analyzed
NL = Not Listed
Proc. = Processing
TCDD = tetrachlorodibenzodioxin
TEQ = Toxicity Equivalent Quotient
-- sample analyzed, result below MCL.

2.5.6.5.2 Production Wells

During the RI, the three on-site existing production wells were sampled in December 1997 and were analyzed for VOCs, SVOCs, metals, pesticides/PCBs (except one well), and dioxins/furans. Two of the wells were sampled again in May 1999 and analyzed for metals and dioxins/furans. None of the VOCs, SVOCs, or pesticides/PCBs exceeded MCLs. All five samples exceeded MCLs for metals and one sample obtained in 1997 exceeded 2,3,7,8-TCDD MCLs for dioxin TEQ. The sample results that exceeded MCLs are listed in Table 11.

Table 11 - Production Well Groundwater Results Exceeding MCLs

Sample ID:			PW-1	PW-2	PW-2	PW-3	PW-3
Sample Area:			E of Sluice	SW Corner (West)		SW Corner (East)	
	MCL[1]	MCL[2]	1997	1997	1999	1997	1999
TURBIDITY (NTU)			NM	NM	9.95	NM	16.9
METALS (µg/L)							
Aluminum	NL	50-200*	--	3,200J	1,710	--	--
Iron	300	300*	15,000	14,000	7,640	11,000	9,820
Manganese	50	50*	150	74	--	110	123
Total Mercury	1.1	2**	2.0	--	--	--	--
Thallium	NL	2	--	--	--	--	2.6B
DIOXINS (ng/L)							
2,3,7,8-TCDD	0.00022	0.03	--	--	--	--	--
TEQ	NL	NL	--	--	--	0.003	--

Notes:
1 North Carolina Administrative Code, Subchapter 2L, Maximum Contaminant Level (MCL)
2 Federal Safe Drinking Water Act MCL
* Secondary MCL - These values are based on aesthetics rather than health effects and are not used by EPA as clean-up goals for Superfund sites.
** inorganic mercury
-- result is below MCL
B = analyte analyzed and value obtained from reading less than Contract Required Detection Limit but greater than Instrument Detection Limit.
J = estimated value
NL = Not Listed
NM = Not Measured
TCDD = tetrachlorodibenzodioxin
TEQ = Toxicity Equivalent Quotient

2.5.6.5.3 Permanent Monitor Wells

During the RI, 8 permanent monitor wells were installed and sampled. Of the 8 well samples obtained in December 1997, all 8 were analyzed for VOCs, SVOCs, metals, pesticides/PCBs and dioxins/furans. Four of the 8 samples were analyzed for Natural Attenuation Parameters. In May 1999, Monitor Well #1 was sampled and analyzed for metals only. Only aluminum, iron and manganese exceeded state groundwater standards and federal secondary MCLs, which are not used as clean-up goals. The sample results that exceeded MCLs are listed in Table 12.

Table 12 - Groundwater Monitor Well Analytical Results Exceeding MCLs

Sample ID:			MW-6S	MW-6D	MW-1	MW-1	MW-2	MS-3	MW-4S	MS-4D	MW-5
Sample Area:			Northwest Upgradient (bkg)		Eastern Border		S. Border	Refinery	Southeast Corner		S Tank Cradle
	MCL[1]	MCL[2]	1997	1997	1997	1999	1997	1997	1997	1997	1997
METALS (µg/L)											
Aluminum	NL	50-200*	8,500	--	--	672	--	1,700	--	1,200	--
Iron	300	300*	3,700	11,000	380	1,860	790	1,700	13,000	11,000	19,000
Manganese	50	50*	--	130	--	142	94	52	140	180	51

Notes:
1 North Carolina Administrative Code, Subchapter 2L, Maximum Contaminant Level
2 Federal Safe Drinking Water Act Maximum Contaminant Level
* Secondary MCL - These values are based on aesthetics rather than health effects and are not used by EPA as clean-up goals for Superfund sites.
bkg = background
NL = not listed
-- means result is below MCL

2.5.6.5.4 Residential and Community Wells

During the RI, three residential wells and one community well were sampled in December 1997 and analyzed for VOCs, SVOCs, metals, pesticides/PCBs and dioxin/furans. The residential wells were within ¼ mile radius of the Site. The community well was within a ½ mile radius of the Site. All results were below MCLs except for two metals, iron and manganese, in the residential wells. The results exceeding MCLs are presented in Table 13.

Table 13 - Residential Well Groundwater Results Exceeding MCLs

Sample ID:			RW-1	RW-2	RW-3
	MCL[1]	MCL[2]	1997	1997	1997
METALS (µg/L)					
Iron	300	300*	1,900	3,000	2,500
Manganese	50	50*	69	92	74

Notes:
1 North Carolina Administrative Code, Subchapter 2L, Maximum Contaminant Level
2 Federal Safe Drinking Water Act Maximum Contaminant Level
* Secondary MCL - These values are based on aesthetics rather than health effects and are not used by EPA as clean-up goals for Superfund sites.

During the RI, analytical data was reviewed for the Prince George Estates Community Wells. The wells were sampled in June of 1994, and May 1996. The results were below Federal MCL levels, but two exceeded State MCL levels (bromoform and chloroform). Neither of these are attributable to the Reasor Chemical Company Site. The results are summarized in Table 14.

Table 14 - Prince George Estates Community Well Historical Data Summary Table

		Sample ID:	PGCW#1	PGCW#1	PGCW#2	PGCW#2
		Date Sampled:	6/94	5/96	6/94	5/96
	MCL[1]	MCL[2]				
VOCs (µg/L)						
Bromodichloromethane	NL	NL	10.9	NA	12.1	NA
Bromoform	0.19	NL	0.75	NA	0.78	NA
Chlorodibromomethane	NL	NL	8.94	NA	9.73	NA
Chloroform	0.19	NL	17	NA	18	NA
Ethylbenzene	29	700	<0.5	0.62	<0.5	0.15
Xylenes	530	10,000	<0.5	3.88	<0.5	1.39

Notes:
< 0.5 = Result was below the detection limit of 0.5 µg/L
1 North Carolina Administrative Code, Subchapter 2L, Maximum Contaminant Level
2 Federal Safe Drinking Water Act Maximum Contaminant Level
NA = Not Analyzed
ND = None Detected and detection limit information is not currently available
NL = Not Listed

2.5.6.6 Liquid Tar Sample

During the RI, a sample of the tar-like material immediately above the sediments in Pond 3 was sampled in May 1999 and analyzed for SVOCs and metals. Results were compared to surface water standards. The concentrations for five metals (copper, iron, lead, silver and zinc) exceeded State surface water standards. The results exceeding surface water standards are included in Table 15.

Table 15 - Liquid Tar Sample, Pond 3 Results Exceeding Surface Water Standards

	Sample ID:	TAR-POND 3
	Sample Area:	Pond 3
	MCL[1]	
METALS (mg/kg)		
Copper	7*	692
Iron	1,000*	15,100
Lead	25	35.9
Silver	0.06*	0.43
Zinc	50*	209

Notes:
1 North Carolina Surface Water Standards
* Numerical ambient surface water quality standard

2.5.7 Location of Contamination and Migration

2.5.7.1 Lateral and Vertical Extent of Contamination

Surface soils are contaminated with PAHs and/or metals above clean-up goals derived from the human health or ecological risk assessments in the following areas: Scrap copper, pipe shop, and drum disposal. Contamination extends to a depth of one foot. The estimated volume of contaminated surface soil is 350 cubic yards (yd^3).

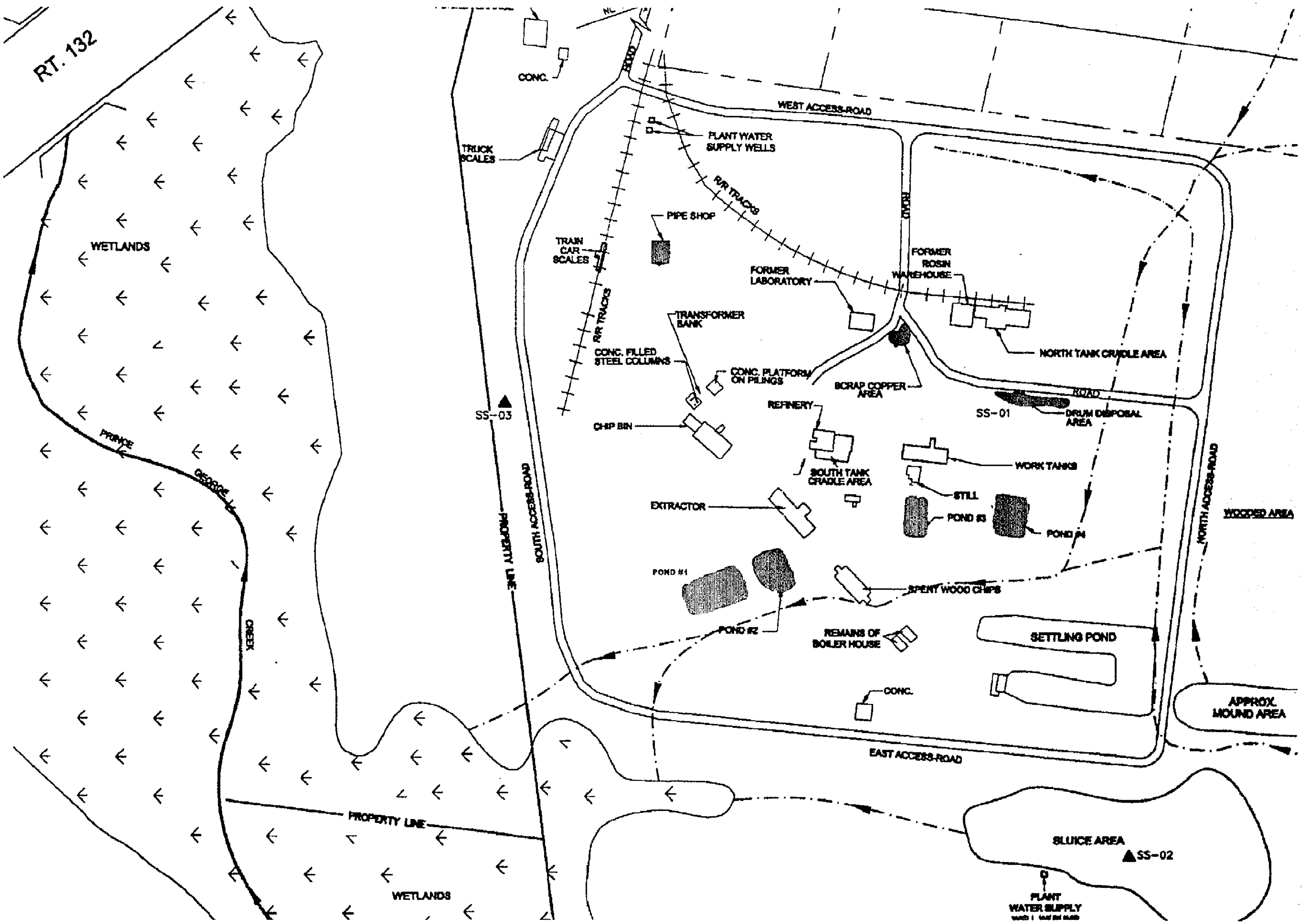
Sediments are contaminated with VOCs, SVOCs, PAHs, and/or metals in the following on-site areas: Pond 1, Pond 2, Pond 3, Pond 4 and drum disposal area. The estimated volume of contaminated sediment is 1,250 yd^3.

Surface waters are contaminated with metals in the following on-site areas: Pond1 and Pond 2 (note: Ponds 3 and 4 were dry during sampling periods). The estimated volume of contaminated pond water is 500,000 gallons (assuming pond 3 and 4 will contain water in the future).

Groundwater at the Site is contaminated with metals at concentrations which exceed State or Federal drinking water standards. The groundwater depths for samples with exceedances range from 12 to 25 feet below the land surface.

The areas of the Site that have contamination exceeding clean-up levels are shown in Figure 2. The areas filled with red are areas of soil contamination. The areas filled with blue are areas of sediment and surface water contamination.

Figure 2 - Areas of Contamination Exceeding Clean-up Levels



2.5.7.2 Current and Potential Future Surface and Subsurface Routes of Human or Environmental Exposure

The property is currently vacant, but is utilized by trespassers. The current routes for human exposure come from direct contact with the contaminated surface soils and surface water. Environmental impacts are occurring currently by exposure of ecological receptors to contaminated soil, sediment and surface water. The most conservative potential future routes of human exposure come from the hypothetical future resident scenario. In that scenario, human exposure could come from direct contact with contaminated surface soil and surface water, in addition to ingestion of contaminated groundwater.

2.5.7.3 Likelihood for Migration

The likelihood for migration of the contaminants of concern is high. Surface soil and surface water contamination exist on site. The site is located near a wetland and Prince George Creek. The creek has been known to flood from time to time. Heavy rains would cause the existing contamination to migrate downgradient. Downgradient migration may affect the wetlands and creek. The contaminants may also migrate into the groundwater, which may migrate off-site.

2.5.8 Groundwater Contamination

During the RI, hydrogeological conditions were characterized during the Geoprobe and monitor well installation, collection of water level data from temporary and monitor well locations, and hydraulic testing of newly installed monitor wells. The water table is typically found in unconsolidated overburden materials. The aquifer ranges in thickness from 17 feet thick on the southwest and northeast portion of the site to 29 feet thick on the southeast portion of the site. The depth to water ranges from approximately 3 to 12 feet. Groundwater flow direction follows site topography, flowing from the higher area contours at the northwestern edge of the site southeast toward the channel of Prince George Creek.

During the RI, WESTON installed 2 bedrock monitor wells and seven Geoprobe borings that terminated at auger refusal, which corresponded to the upper surface of the bedrock aquifer underlying the overburden aquifer. According to boring log data and information gained from the 1985 Geologic Map of North Carolina, the bedrock aquifer is a sandstone unit of the Peedee Formation.

The potentiometric surfaces of the overburden groundwater table were used to estimate the magnitude of the hydraulic gradient in the overburden aquifer. The gradient magnitude was calculated to be 0.006 ft/ft. Hydraulic conductivity in the top of bedrock monitor wells, ranged from 2.1 feet per day (ft/day) at MW-1 to 0.04 ft/day at MW-3, with an average of 0.9 ft/day. This indicated the wells are screened in silts, sandy silts, and clayey sands. The range in hydraulic conductivities reflects the heterogeneity of overburden soils.

2.6 Current and Potential Future Land and Water Uses

2.6.1 Land Uses

The Site is currently vacant and is zoned for industrial use. There is evidence that it has been used for hunting purposes. There is a sign posted on a tree that states that the property is utilized by the Sheriff's department for training purposes (this hasn't been confirmed with the Sheriff's office, though). Correspondence from a nearby resident indicated that teens and adults utilize the property for recreational purposes such as riding 4-wheelers, motorcycles and possibly horses. Surrounding property use is both residential and industrial. Several people have contacted the RPM with an interest in purchasing the property for development. Because the adjacent properties are zoned both residential and industrial, it is possible that the property could be rezoned as residential.

2.6.2 Groundwater Uses

Because the Site is vacant, there are currently no groundwater users at the Site. A survey of groundwater use in the site vicinity indicated no municipal water supply wells or distribution lines within four miles of the Site. Domestic and community wells supplied the entire population within four miles of the Site. The closest community well is located in a mobile home park 1,500 to 2,500 feet southwest of the site (Shady Haven MHP). Another community well is located 3,000 feet southeast of the site in a housing subdivision (Prince George Estates). The closest domestic well is located 1,200 feet from the site. There are three production wells located on-site which were utilized as water supply for industrial purposes. These three wells tap into the Peedee and Castle Hayne aquifers and range in depth from 148 to 150 feet below ground surface. Because of the lack of municipal water supply lines, it is anticipated that future groundwater use for the Site would include drinking water.

2.7 Summary of Site Risks

2.7.1 Summary of Human Health Risk Assessment

The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this Site.

2.7.1.1 Identification of Chemicals of Concern

The Baseline Human Health Risk Assessment evaluated soil, surface water and groundwater. Only the soil and groundwater media were found to have Chemicals of Concern (COCs). Those COCs, their frequency of detection, range of concentrations, and the exposure point concentrations are found in Tables 16 and 17.

Table 16 - Baseline Human Health Risk Assessment COCs - Surface Soil

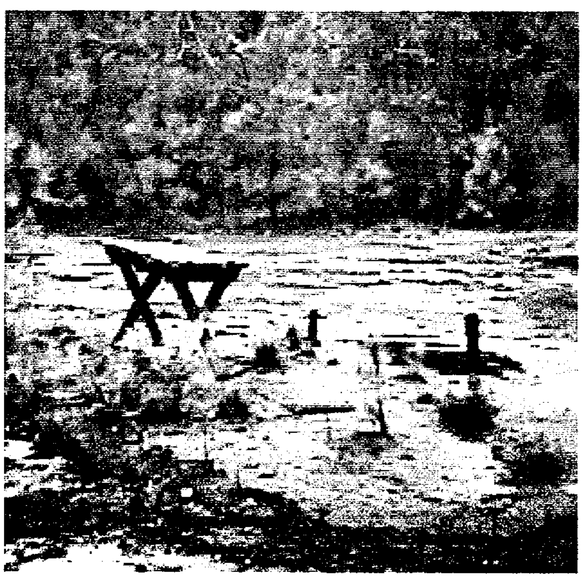
	Frequency of Detection	Range of Detected Concentration	Exposure Point Concentration
SVOCs		µg/kg	µg/kg
Benzo(a)anthracene	19/94	47-4400	1960 (UCL)
Benzo(b &/or k)fluoranthene	24/94	41-5300	1950 (UCL)
Benzo(a)pyrene	19/94	42-3900	2010 (UCL)
Dibenzo(a,h)anthracene	5/94	49- 360	360 (max)
Indeno(1,2,3-cd)pyrene	16/94	45-2100	1890 (UCL)
DIOXINS/FURANS		ng/kg	ng/kg
TEQ	4/4	0.5-15	15 (max)
METALS		mg/kg	mg/kg
Antimony	5/19	0.73- 67	41.55 (UCL)
Arsenic	2/19	0.68- 10	1.09 (UCL)
Copper	19/19	1.6 -5900	5900 (max)

Notes:
(max) = Exposure Point Concentration is the maximum concentration found on-site in that media
(UCL) = Exposure Point Concentration is the 95% Upper Confidence Limit
TEQ = Toxicity Equivalent Quotient

Table 17 - Baseline Human Health Risk Assessment COCs - Groundwater

	Frequency of Detection	Range of Detected Concentration	Exposure[1] Point Concentration
DIOXINS/FURANS		ng/L	ng/L
TEQ	5/12	0.0001-0.003	0.0023
METALS		µg/L	µg/L
Aluminum	14/18	25.2-20,600	16,567
Arsenic	4/18	1.6-3	2.3
Thallium	4/18	2.5-8.4	5.2

Notes:
1 Exposure point concentrations were based on maximally impacted wells
TEQ = Toxicity Equivalent Quotient



December 11, 2001 - Reasor Chemical Company Site

Photo #7 - Picnic Table near boiler house

Photo #8 - Sign posted on Property

2.7.1.2 Exposure Assessment

There were four potentially exposed populations evaluated in the Baseline Human Health Risk Assessment. The four Exposure Pathway Scenarios (EPS) evaluated included Current On-Site Trespassers (EPS-1), Future Child and Adult Residents (EPS-2), Future Industrial Worker (EPS-3), and Future Construction Workers (EPS-4). The exposure pathways evaluated can be found in the Conceptual Site Model, which is located in Section 2.5.1 of this ROD. The exposure assumptions used for the major exposure pathways for each scenario are summarized in Table 18.

Table 18 - Exposure Assumptions

	EPS-1 Trespasser	EPS-2 Future Child Resident	EPS-2 Future Adult Resident	EPS-3 Future Industrial Worker	EPS-4 Future Construction Worker
Soil Ingestion Rate	100 mg/day	200 mg/day	100 mg/day	50 mg/day	480 mg/day
Skin Surface Area available for contact	3,400 cm^2/day	1,800 cm^2/day	5,000 cm^2/day	5,000 cm^2/day	5,000 cm^2/day
Area Factor	1 mg/cm^2	1 mg/cm^2	1 mg/cm^2	1 mg/cm^2	1 mg/cm^2
Particulate Emission Factor[1]	$6.6 \times 10^{+8}$ m^3/kg	$1.32 \times 10^{+9}$ m^3/kg	$1.32 \times 10^{+9}$ m^3/kg	$6.6 \times 10^{+8}$ m^3/kg	$6.6 \times 10^{+8}$ m^3/kg
Inhalation Rate	10 m^3/day	15 m^3/day	20 m^3/day	20 m^3/day	20 m^3/day
Exposure Frequency	60 days/year	350 days/year	350 days/year	250 days/year	130 days/year
Exposure Duration	10 years	6 years	24 years	25 years	1 year
Body Weight	45 kg	15 kg	70 kg	70 kg	70 kg
Averaging Time	Exposure duration (years) x 365 days/year for non-cancer risk 70 years x 365 days/year for cancer risk				
Dermal Absorption Factor	Chemical Specific. If not available, 0.01 for organic compounds, 0.001 for inorganic compounds.				
Notes: 1 Assumes 50% vegetative cover for residents, 0% vegetative cover for other scenarios.					

2.7.1.3 Toxicity Assessment

The BHHRA utilized information from the Integrated Risk Information System (IRIS), Health Effects Assessment Summary Tables (HEAST) and National Center for Environmental Assessment (NCEA). The assessment looked at both carcinogenic and non-carcinogenic effects. Table 19 provides carcinogenic risk information which is relevant to the contaminants of concern in both soil and ground water.

Table 19 - Cancer Toxicity Data Summary

Pathway: Ingestion, Inhalation, and Dermal						
Chemical of Concern	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Dermal Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Cancer Guideline Description	Source	Date
Benzo(a)anthracene	0.73	1.5	0.31	B2	IRIS[1]	Oct. 1999
Benzo(b)fluoranthene	0.3	1.5	0.31	B2	IRIS[1]	Oct. 1999
Benzo(k)fluoranthene	0.073	0.15	0.031	B2	IRIS[1]	Oct. 1999
Benzo(a)pyrene	7.3	15	3.1	B2	IRIS[1]	Oct. 1999
Dibenzo(a,h)anthracene	7.3	15	3.1	B2	IRIS[1]	Oct. 1999
Indeno(1,2,3-cd)pyrene	0.73	1.5	0.31	B2	IRIS[1]	Oct. 1999
2,3,7,8-TCDD	1.5×10^5	3.0×10^5	1.5×10^5	B2	HEAST	1997
Aluminum	--	--	--	--	--	--
Antimony	--	--	--	--	--	--
Arsenic	1.5	1.5	15	A	IRIS	Oct. 1999
Copper	--	--	--	D	IRIS	Oct. 1999
Thallium	--	--	--	D	IRIS	2002

Notes:
1 Of the six Polycyclic Aromatic Hydrocarbons (PAHs) listed in this table, only benzo(a)pyrene had an IRIS-verified slope factor. Toxicity equivalent factors from an EPA Office of Research and Development document (EPA/600/R-93/089, July 1993) were used to derive the slope factors for the other PAHs. IRIS is the source for the cancer class designations, but not the slope factors for the other PAHs.
- : No information available
IRIS: Integrated Risk Information System, EPA
HEAST: Health Effects Assessment Summary Tables, EPA

A - Human carcinogen
B2 - Probable human carcinogen - Indicates sufficient evidence in animals and inadequate or no evidence in humans
D - Not classifiable as a human carcinogen

Table 20 on the following page provides non-carcinogenic risk information which is relevant to the contaminants of concern in both soil and ground water. All of the COCs except for 2,3,7,8-TCDD have toxicity data indicating their potential for adverse non-carcinogenic health effects in humans. At this time, inhalation reference concentrations are not available for any of the COCs except aluminum.

Table 20 - Non-Cancer Toxicity Data Summary

Pathway: Ingestion, Inhalation, and Dermal								
Chemical of Concern	Chronic/ Subchronic	Oral RfD value (mg/kg-day)	Dermal RfD (mg/kg-day)	Primary Target Organ	Combined Uncertainty / Modifying Factors	Inhalation Reference Dose (mg/kg-day)	Source	Dates of RfD: Target Organ
Benzo(a) anthracene	Chronic Subchronic	0.030 0.30	0.015 0.15	Kidney effects	3000/1 300/1	--	IRIS [1] HEAST	Oct. 1999 1997
Benzo(b) fluoranthene	Chronic Subchronic	0.030 0.30	0.015 0.15	Kidney effects	3000/1 300/1	--	IRIS [1] HEAST	Oct. 1999 1997
Benzo(k) fluoranthene	Chronic Subchronic	0.030 0.30	0.015 0.15	Kidney effects	3000/1 300/1	--	IRIS [1] HEAST	Oct. 1999 1997
Benzo(a) pyrene	Chronic Subchronic	0.030 0.30	0.015 0.15	Kidney effects	3000/1 300/1	--	IRIS [1] HEAST	Oct. 1999 1997
Dibenzo(a,h) anthracene	Chronic Subchronic	0.030 0.30	0.015 0.15	Kidney effects	3000/1 300/1	--	IRIS [1] HEAST	Oct. 1999 1997
Indeno(1,2,3-cd)pyrene	Chronic Subchronic	0.030 0.30	0.015 0.15	Kidney effects	3000/1 300/1	--	IRIS [1] HEAST	Oct. 1999 1997
2,3,7,8-TCDD	--	--	--	--	--	--	--	--
Aluminum	Chronic	1.0	0.50	--	--	1.0×10^{-3}	NCEA	--
Antimony	Chronic Subchronic	4.0×10^{-4} 4.0×10^{-4}	8.0×10^{-5} 8.0×10^{-5}	Chr: Longevity, blood glucose, cholesterol Sub: Increased mortality; altered blood chemistries	1000/1 1000/1	--	IRIS HEAST	Oct. 1999 1997
Arsenic	Chronic Subchronic	3.0×10^{-4} 3.0×10^{-4}	6.0×10^{-4} 3.0×10^{-4}	Chr: Hyperpig-mentation and keratosis; poss. vascular complications Sub: Hyperpig-mentation and keratosis	3/1 3/1	--	IRIS HEAST	Oct. 1999 1997
Copper	Chronic & Subchronic	3.7×10^{-2}	7.4×10^{-3}	Gastrointestinal irritation	300/3	--	IRIS HEAST	Oct. 1999 1997
Thallium	Chronic	8.0×10^{-5}	1.6×10^{-5}	Liver, Blood, Hair	3000/1	--	IRIS	Oct. 1999

Notes:
1 The source for the values for the six Polycyclic Aromatic Hydrocarbons are not IRIS/HEAST, but a surrogate approach using the pyrene toxicity values from IRIS/HEAST.
--: No information available
IRIS: Integrated Risk Information System, EPA
HEAST: Health Effects Assessment Summary Tables, EPA
NCEA: National Center for Environmental Assessment (EPA Provisional Value)

2.7.1.4 Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$Risk = CDI \times SF$$

where:

Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as (mg/kg-day)-1.

An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 1×10^{-4} to 1×10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. A RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). A HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. A HI less than 1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. A HI greater than 1 indicates that site-related exposures may present a risk to human health. The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where:

CDI = Chronic daily intake
RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

The BHHRA did not evaluate sediments because it was felt that human exposure was unlikely or extremely limited due to the sediments being covered by water. Risks that exceed a Hazard Index of 1 or a carcinogenic risk of 1×10^{-6} are presented in Table 21. Risks for surface water (combined drainage ditches and ponds) and risks for EPS-4 (Future Construction Worker) were evaluated but had hazard indices of less than one and cancer risks less than 1×10^{-6}, and therefore are not included in Table 21. The summed risks are presented using only one significant figure.

Table 21 - Summary of Hazard Indices and Carcinogenic Risks

Media	Scenario	Total Hazard Index	Total Cancer Risk
Risks from Soil	EPS-1	0.1	$4x10^{-6}$ ✓
	EPS-2 Child	4 ✓	$3x10^{-5}$ ✓
	EPS-2 Adult	0.5	$3x10^{-5}$ ✓
	EPS-2 Combined	–	$6x10^{-5}$ ✓
	EPS-3	0.2	$1x10^{-5}$ ✓
Risks from Groundwater	EPS-2 Child	8 ✓	$2x10^{-5}$ ✓
	EPS-2 Adult	3 ✓	$4x10^{-5}$ ✓
	EPS-2 Combined	–	$6x10^{-5}$ ✓
	EPS-3	1.2 ✓	$1x10^{-5}$ ✓
Combined Risks	EPS-1	0.1	$4x10^{-6}$ ✓
	EPS-2 Child	12 ✓	$5x10^{-5}$ ✓
	EPS-2 Adult	4 ✓	$6x10^{-5}$ ✓
	EPS-2 Combined	–	$1x10^{-4}$ ✓
	EPS-3	1.4 ✓	$3x10^{-5}$ ✓

Notes:
EPS-1 Current Trespasser
EPS-2 Future Resident
EPS-3 Future Industrial Worker
✓ Scenarios exceeding a Hazard Index of 1 or a Cancer Risk of $1x10^{-6}$

Table 22 includes a summary of chemicals and exposure routes exceeding a cancer risk of $1x10^{-6}$.

Table 22 - Chemicals and Exposure Routes Exceeding a Carcinogenic Risk of $1x10^{-6}$

SOIL					
Receptor:	EPS-1	EPS-2 C	EPS-2 A	EPS-2 Co	EPS-3
SVOCs					
Benzo(a)anthracene		$1.9x10^{-6}$	$1.3x10^{-6}$	$3.2x10^{-6}$	
Benzo(a)pyrene	$1.1x10^{-6}$	$1.9x10^{-5}$	$1.4x10^{-5}$	$3.3x10^{-5}$	$7.7x10^{-6}$
Benzo(b)fluoranthene		$1.8x10^{-6}$	$1.3x10^{-6}$	$3.2x10^{-6}$	
Dibenzo(a,h)anthracene		$3.4x10^{-6}$	$2.5x10^{-6}$	$5.9x10^{-6}$	$1.4x10^{-6}$
Indeno(1,2,3-cd)pyrene		$1.8x10^{-6}$	$1.3x10^{-6}$	$3.1x10^{-6}$	
Dioxin/Furans					
2,3,7,8-TCDD	$2.5x10^{-5}$	$3.8x10^{-6}$	$4.2x10^{-6}$	$8.0x10^{-6}$	$2.8x10^{-6}$
Metals					
Arsenic		$1.8x10^{-6}$		$2.6x10^{-6}$	
Exposure Routes					
Dermal Contact	$2.9x10^{-6}$	$5.6x10^{-6}$	$1.3x10^{-5}$	$1.9x10^{-5}$	$9.9x10^{-6}$
Soil Ingestion	$1.3x10^{-6}$	$2.8x10^{-5}$	$1.2x10^{-5}$	$4.0x10^{-5}$	$4.4x10^{-6}$
GROUNDWATER					
Dioxin/Furans					
2,3,7,8-TCDD		$1.9x10^{-6}$	$3.2x10^{-6}$	$5.1x10^{-6}$	$1.2x10^{-6}$
Metals					
Arsenic		$1.9x10^{-5}$	$3.2x10^{-5}$	$5.1x10^{-5}$	$1.2x10^{-5}$
Exposure Routes					
Groundwater Ingestion		$2.1x10^{-5}$	$3.5x10^{-5}$	$5.6x10^{-5}$	$1.3x10^{-5}$
COMBINED RISKS					
SVOCs					
Benzo(a)anthracene		$1.9x10^{-6}$	$1.3x10^{-6}$	$3.2x10^{-6}$	
Benzo(a)pyrene	$1.1x10^{-6}$	$1.9x10^{-5}$	$1.4x10^{-5}$	$3.3x10^{-5}$	$7.7x10^{-6}$
Benzo(b)fluoranthene		$1.8x10^{-6}$	$1.3x10^{-6}$	$3.2x10^{-6}$	
Dibenzo(a,h)anthracene		$3.4x10^{-6}$	$2.5x10^{-6}$	$5.9x10^{-6}$	$1.4x10^{-6}$
Indeno(1,2,3-cd)pyrene		$1.8x10^{-6}$	$1.3x10^{-6}$	$3.1x10^{-6}$	
Dioxin/Furans					
2,3,7,8-TCDD	$2.6x10^{-6}$	$5.9x10^{-6}$	$8.0x10^{-6}$	$1.4x10^{-5}$	$4.1x10^{-6}$
Metals					
Arsenic		$2.0x10^{-5}$	$3.3x10^{-5}$	$5.3x10^{-5}$	$1.2x10^{-5}$
Exposure Routes					
Soil Pathways	$4.2x10^{-6}$	$3.4x10^{-5}$	$2.5x10^{-5}$	$5.9x10^{-5}$	$1.4x10^{-5}$
Groundwater Pathways		$2.1x10^{-5}$	$3.5x10^{-5}$	$5.6x10^{-5}$	$1.3x10^{-5}$

Notes:
EPS-1 = Current Trespasser
EPS-2 C = Future Child Resident
EPS-2 A = Future Adult Resident
EPS-2 Co = Combined Future Child and Adult Resident
EPS-3 Future Industrial Worker
• Darkest shading indicates risks were below $1x10^{-6}$ for that chemical/exposure route for that receptor.
• EPS-4, Future Construction Worker, had carcinogenic risks less than $1.0x10^{-6}$, and therefore is not included.

There were only two receptors which had Hazard Indexes greater than one. These were EPS-2 C and EPS-2 A, Future Child Resident and Future Adult Resident. Only four inorganic compounds had Hazard Indexes greater than one. These included Aluminum, Antimony, Copper and Thallium. Table 23 includes a summary of chemicals and exposure routes exceeding a Hazard Index of 1.

Table 23 - Chemicals and Exposure Routes Exceeding a Hazard Index of 1

SOIL		
Receptor:	EPS-2 C	EPS-2 A
Metals		
Antimony	1.4	
Copper	2.1	
Exposure Routes		
Soil Ingestion	3.7	
GROUNDWATER		
Metals		
Aluminum	1.1	
Thallium	4.2	1.8
Exposure Routes		
Groundwater Ingestion	7.6	3.2
COMBINED RISKS		
Metals		
Aluminum	1.1	
Antimony	1.4	
Copper	2.1	
Thallium	4.3	1.8
Exposure Routes		
Soil Pathways	3.9	
Groundwater Pathways	7.9	3.4
Note: EPS-2 C = Future Child Resident EPS-2 A = Future Adult Resident Darkest shading indicates Hazard Index was below 1 for that chemical/exposure route for that receptor. Only receptors and chemicals with Hazard Indices greater than 1 are presented in this table.		

2.7.1.5 Uncertainties

Uncertainties in the BHHRA included several factors. These are discussed in the following paragraphs.

Some of the analytical data utilized in the risk assessment were qualified as "J". This qualifier indicates that the actual concentration may be higher or lower than the amount reported.

Non-detected chemicals were reported by the laboratory as less than the Sample Quantification Limit (SQL). In the risk assessment, if a chemical was reported as nondetect, it was assumed to be present at one-half of the SQL for that sample in the calculation of the 95% upper confidence limit of the mean concentration. This may result in either over- or under-estimation of the actual exposure concentration.

In the risk assessment it was conservatively assumed that all total chromium results were in the hexavalent form (Chromium VI). This assumption will likely result in overestimation of risk. However, for all exposure pathways and routes, chromium did not generate an excess cancer risk greater than $1x10^{-6}$ or a hazard quotient greater than 1.

The risks posed by contaminants in sediment may have been underestimated due to limited sample information (i.e. pesticides/PCBs not analyzed in pond sediments). The underestimation would occur if the maximally impacted areas were not characterized.

The exposure assumptions used to calculate risks were, in general, conservative. This generally results in the overestimation of risks. For several Chemicals of Potential Concern (COPCs), the maximum concentrations were used instead of the 95 percent UCL. This typically results in the overestimation of risk. Quantitative risk calculations for future residential exposure to groundwater were calculated on the maximally impacted wells, or worst-case analysis.

The conservative assumptions used in the toxicity assessment generally result in an overestimation of risks. However, lack of RfDs for certain COPCs may have resulted in both over- and underestimation of the risks.

Another uncertainty factor for three inorganic compounds in groundwater sample results was not addressed in the BHHRA. After the BHHRA was completed, EPA Region 4's Office of Technical Services sent out "OTS Alert #2", dated January 31, 2001, regarding: "Use of the ICP analytical method (CLP SOW ILM04.1, SW-846 6010, MCAWW 200.7) for drinking water samples may result in false positive detections of arsenic, lead, and/or thallium above their respective MCLs". That Alert states, "The current CLP Statement of Work for inorganic analytical methods includes the techniques of Inductively Coupled Plasma (ICP) and Atomic Absorption (AA). At the time the Statement of Work was developed, most laboratories used a combination of these techniques with Atomic Absorption being the method of choice for low-level work, particularly for certain Metals which might not be detected by ICP. Over the last few years, most laboratories have changed to using a Trace version of ICP and doing little or no work with AA. During this time, we have observed few detection level problems for non-detects. However, some low-level detections at Region 4 sites have been called into question for a number of cases, particularly involving Arsenic, Lead, and Thallium. In most of these cases, re-sampling followed by re-analysis at the Regional laboratory in Athens, GA has shown the CLP low-level detects to be potential false positives."

This may be applicable to the Reasor Chemical Company Site. The only detections of arsenic and thallium above the most conservative remedial goal option values (less than current MCL) were from samples obtained in 1999 which were analyzed through the CLP program. The concentrations that were detected were all flagged with a qualifier that the analyte was analyzed for and reported value obtained from a reading less than Contract Required Detection Limit but greater than or equal to Instrument Detection Limit, which would be considered "low-level" detections. Since groundwater has not been resampled, it is questionable as to whether these are potentially "false positive" results.

An evaluation of all the uncertainties utilized in the BHHRA suggest that the risks have been overestimated. Thus, EPA's goal of ensuring that health risks are not underestimated has been achieved.

2.7.2 Summary of Ecological Risk Assessment

2.7.2.1 Identification of Chemicals of Concern

The Chemicals of Potential Concern (COPCs) which were identified in the Baseline Ecological Risk Assessment (BERA) for surface soil are included in Table 24.

Table 24 - Occurrence, Distribution, and Selection of Soil COPCs from RI data

Chemical of Potential Concern	Minimum Conc.	Maximum Conc.	Mean Conc.	Frequency of Detection	Back-ground Conc.	Alternative Toxicity Value (ATV)	ATV Source	HQ	COPC?
VOCs	μg/kg	μg/kg	μg/kg		μg/kg	μg/kg			
Toluene	3	10,000	NA	9/92	--	3,000	Beyer	3.3	Yes
Xylenes	2	14,000	NA	12/92	--	10,000	EDQL	1.4	Yes
SVOCs	μg/kg	μg/kg	μg/kg		μg/kg	μg/kg			
Total PAHs	NA	51,740	NA		--	20,000	Beyer	2.6	Yes
Dioxins/Furans	ng/kg	ng/kg	ng/kg		ng/kg	ng/kg			
2,3,7,8-TCDD (mammal) Equivalents (bird)	0.463 0.805	15.48 26.76	NA	4/4	4.1 3.34	NSL NSL			Yes
Metals	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg			
Copper	1.6	5,900	NA	19/19	4	100	Beyer	59	Yes
Lead	3.2	410	NA	19/19	7.4	150	Beyer	2.7	Yes
Zinc	2.1	2,300	NA	18/19	5.9	500	Beyer	4.6	Yes

Notes:
Conc. = Concentration
NA = Information Not Available
NSL = No Screening Level
HQ = Hazard Quotient
-- = Below Detection Limit

EDQL, EPA Region 5 Ecological Data Quality Levels (EPA 2000)
Beyer (1990), Column B, Evaluating Soil Contamination. US Fish & Wildlife Service, Biological Report 90(2)

During the Ecological Risk Assessment (ERA), additional soil samples were obtained to determine the final Chemicals of Concern (COCs). The final COC list was not derived solely from those contaminants with HQ's greater than one. Toxicity testing and Food Chain Modeling were conducted and that information was factored into the final COC decision (further described in later sections of the ROD). The results of the December 2001 soil sampling are summarized in Table 25.

Table 25 - Occurrence, Distribution, and Selection of Soil COCs from ERA data

Chemical of Potential Concern	Minimum Conc.	Maximum Conc.	Mean Conc.	Frequency of Detection	Back-ground Conc.	Alternative Toxicity Value (ATV)	ATV Source	HQ	COC?
VOCs	µg/kg	µg/kg	µg/kg		µg/kg	µg/kg			
Toluene	--	--	--	0/6	--	3,000	Beyer	0	No
Xylenes	--	--	--	0/6	--	10,000	EDQL	0	No
SVOCs	µg/kg	µg/kg	µg/kg		µg/kg	µg/kg			
Total PAHs	383	79,560	18,331	6/6	376.8	20,000	Beyer	4	No
Dioxins/Furans	ng/kg	ng/kg	ng/kg		ng/kg	ng/kg			
2,3,7,8-TCDD (mammal) Equivalents (birds)	0.508 0.65	907.94 1272	163.53 230.64	6/6 6/6	10.713 3.705	200 200	Miller et al	4.5 6.4	No No
Metals	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg			
Copper	37	99,000	17,096	6/6	13	100	Beyer	990	Yes
Lead	42	2,100	424	6/6	330	150	Beyer	14	Yes
Zinc	25	840	218	6/6	240	500	Beyer	1.7	No

Notes:
Conc. = Concentration HQ = Hazard Quotient
-- = Below Detection Limit

EDQL, EPA Region 5 Ecological Data Quality Levels (EPA 2000)
Beyer (1990), Column B, Evaluating Soil Contamination. US Fish & Wildlife Service, Biological Report 90(2)
Miller et al (1973)

The COPCs which were identified in the BERA for sediment are included in Table 26.

Table 26 - Occurrence, Distribution, and Selection of Sediment COPCs from RI data

Chemical of Potential Concern	Minimum Conc.	Maximum Conc.	Mean Conc.	Frequency of Detection	Back-ground Conc.	Alternative Toxicity Value (ATV)	ATV Source	HQ	COPC?
VOCs	µg/kg	µg/kg	µg/kg		µg/kg	µg/kg			
Toluene	6	500,000	NA	7/18	14.3	8,050	DiToro	62	Yes
SVOCs	µg/kg	µg/kg	µg/kg		µg/kg	µg/kg			
(3-and/or 4-) Methylphenol	94	10,000	NA	3/18	--	50	MHSPE	200	Yes
Total PAHs	NA	85,600	NA	3/18	--	13,660	EPA	6.3	Yes
Dioxins/Furans	ng/kg	ng/kg	ng/kg		ng/kg	ng/kg			
2,3,7,8-TCDD (mammal) Equivalents (fish) (bird)	0.033 0.008 0.008	602 602 603	NA NA NA	NA NA NA	1.865 1.952 2.31	2.5 60 21	EPA	241 10 29	Yes Yes Yes
Metals	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg			
Copper	5.2	655	NA	5/7	--	197	Smith	3.3	Yes

Notes:
Conc. = Concentration HQ = Hazard Quotient
-- = Below Detection Limit NA = Information not Available
NSL = No Screening Level

DiToro and McGrath, 2000
MHSPE (2000), Ministry of Housing Spatial planning and Environment, Target value
EPA (1996a). ARCS; Probable Effects Concentration (PEC)
Smith et al (1996); Freshwater Sediment PEL's

During the ERA, additional sediment samples were obtained to determine the final COCs. The final COC list was not derived solely from those contaminants with HQ's greater than one. Toxicity testing and Food Chain Modeling were conducted and that information was factored into the final COC decision (further described in later sections of the ROD). The results of the December 2001 sediment sampling are summarized in Table 27.

Table 27 - Occurrence, Distribution, and Selection of Sediment COCs from ERA data

Chemical of Potential Concern	Minimum Conc.	Maximum Conc.	Mean Conc.	Frequency of Detection	Back-ground Conc.	Alternative Toxicity Value (ATV)	ATV Source	HQ	COC?
VOCs	µg/kg	µg/kg	µg/kg		µg/kg	µg/kg			
Toluene	4.1	29,000	8,075	4/4	--	8,050	DiToro	3.6	Yes
Methylethyl Ketone	--	1,200	NA	1/4	--	136.96	DiToro	8.8	Yes
Methylcyclohexane	4800	30,000	18,200	4/4	--	9,760	DiToro	3.1	Yes
SVOCs	µg/kg	µg/kg	µg/kg		µg/kg	µg/kg			
(3-and/or 4-) Methylphenol	4600	56,000	NA	2/4	--	50	MHSPE	1120	Yes
Total PAHs	277	218,690	64,364	4/4	--	13,660	EPA	16	Yes
Dioxins/Furans	ng/kg	ng/kg	ng/kg		ng/kg	ng/kg			
2,3,7,8-TCDD Equivalents (mammal)	0.996	13.74	5.88	4/4	10.1	25	EPA	0.40	No
(fish)	0.775	7.07	3.59	4/4	8.753	600		0.09	No
(bird)	0.936	9.55	4.71	4/4	16.54	210		0.08	No
Metals	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg			
Copper	100	920	34	4/4	475	197	Smith	4.67	Yes

Notes:
Conc. = Concentration
-- = Below Detection Limit
NSL = No Screening Level
HQ = Hazard Quotient
NA = Information not Available

DiToro and McGrath, 2000
MHSPE (2000), Ministry of Housing Spatial planning and Environment, Target value
EPA (1996a). ARCS; Probable Effects Concentration (PEC)
Smith et al (1996); Freshwater Sediment PEL's

No COPCs were identified in the BERA for surface water other than a potential for metals to be included after further sampling data is obtained. The VOC, SVOC and Dioxin/Furan data was reviewed and results were below the Alternative Toxicity Values. Only six samples were analyzed for metals during the RI, and most of those were from off-site locations. Therefore, there was insufficient data to evaluate whether metals were on-site COPCs.

During the ERA, additional surface water samples were obtained to determine the final COCs. The final surface water COCs were those with HQ's greater than one when compared to State and Federal surface water criteria, with the exception of aluminum. Aluminum had a HQ of 3.2, but the background concentration was more than twice the concentration found in Site samples. The results of the December 2001 surface water sampling with HQ>1 are summarized in Table 28, located on the following page.

Table 28 - Occurrence, Distribution, and Selection of Surface Water COCs from ERA data

Chemical of Potential Concern	Minimum Conc.	Maximum Conc.	Mean Conc.	Frequency of Detection	Back-ground Conc.	Alternative Toxicity Value	ATV Source	HQ	COC?
Metals	µg/L	µg/L	µg/L		µg/L	µg/L			
Aluminum	240	280	260	2/2	680	87	NRWQC	3.2	No
Copper	6.1	61	33.6	2/2	10	**	NRWQC	19.7	Yes
Iron	4,800	6,900	5,850	2/2	--	1000	NRWQC	6.9	Yes
Lead	8.6	35	22	2/2	18	**	NRWQC	80.8	Yes
Zinc	41	51	61	2/2	--	**	NRWQC	2.17	Yes

Key:
Conc. = Concentration
-- = Below Detection Limit
HQ = Hazard Quotient
** = Hardness Dependent

EPA NRWQC (1999). Freshwater Criteria Continuous Concentration/Protection of water and fish

2.7.2.2 Exposure Assessment

On September 7, 2000, personnel from EPA-SESD, U.S. Fish & Wildlife Service, Integrated Laboratory Systems, Inc. (ILS), Environmental Services Assistance Team (ESAT) Contractor, and National Oceanic and Atmospheric Administration (NOAA) conducted a site visit. Vegetation cover at the Site is a mix of mid-successional pine and palustrine forested and scrub/shrub wetlands (but mostly 50-60 feet tall loblolly pine on uplands). Depressions and drainage ditches on the site are bordered predominantly by red maple, wax myrtle, river cane, several species of bay, and soft rush. The open water areas were bordered by cattails, soft rush, bulrush, sedges, and wax myrtle. These are in the sub-basin of Prince George Creek, which just downgradient of the Site broadens as a cypress swamp. There was stagnant water in the ponds. No benthic macroinvertebrates were found in the ponds, however, mosquitofish were observed. Different plant and animal species that were observed during the September 2000 visit are included in Table 29. Table 30 includes a list of rare animal and plant species within 4 miles of the Site.

Table 29 - Vegetation, Bird, and Animal Species Observed at the Site

	Vegetation	
White pine (*Pinus strobus*)	Muscadine (*Vitis rotundifolia*)	Rush (*Juncus* sp.)
Sweetgum (*Liquidambar styraciflua*)	Ebony spleenwort (*Asplenium platyneuron*)	White and yellow composites (Asteraceae)
Tulip tree (*Liriodendron tulipifera*)	Greenbrier (*Smilax rotundifolia*)	Purple gerardia (*Agalinis purpurea*)
Cherry (*Prunus* sp.)	Royal fern (*Osmunda regalis*)	Sedges (*Cyperus* sp.)
Red maple (*Acer rubrum*)	Wire grass (Poaceae)	Goldenrod (*Solidago* sp.)
Oak trees (*Quercus* sp.)	Umbrella grass (*Fuirena* sp.)	Candyweed (*Polygala lutea*)
Sycamore (*Platanus occidentalis*)	Pokeweed (*Phytolacca rigida*)	Wild ginger (*Asarum canadense*)
Hairy bush clover (*Lespedeza* sp.)	Cinnamon fern (*Osmunda cinnamomea*)	Passion-flower (*Passiflora incarnata*)
Milkweed (*Asclepias* sp.)	Meadow beauty (*Rhexia* sp.)	Wax myrtle (*Myrica cerifera*)
Cattails (*Typha* sp.)	Mushrooms and other fungi	Bladderwort (*Utricularia* sp.)
	Birds	
Carolina chickadee (*Parus carolinensis*)	Carolina wren (*Thryothorus ludovicianus*)	Hawk (*Buteo* sp.)
Hairy woodpecker (*Picoides villosus*)	American crow (*Corvus brachyrhynchos*)	Great crested flycatcher (*Myiarchus crinitus*)
Northern mockingbird (*Mimus polyglottos*)	Belted kingfisher (*Ceryle alcyon*)	Northern flicker (*Colaptes auratus*)
Turkey vulture (*Cathartes aura*)		
	Animals	
Spiders (Araneae)	Bumble bees (Hymenoptera)	Butterflies (Lepidoptera)
Mole (Talpidae)	Crickets (Gryllidae)	Chiggers
Lizards (Squamata)	Beaver (*Castor canadensis*)	Oyster shells (Ostreidae)
Dragon flies (Odonata)	Fire ants (Hymenoptera)	Mosquito fish (*Gambusia* sp.)
White-tailed deer (*Odocoileus virginianus*)	Dog	Black racers (*Coluber constrictor*)

Table 30 - Rare Animal and Plant Species Within 4 Miles of the Site

Rare Species Name	Radial Distance (miles)	Downstream Distance (miles)
Animal		
American alligator (*Alligator mississippiensis*)	2.5 W	3.5 - 10.5
Dismal swamp eastern shrew (*Sorex longirostris*)	2.3 S	NA
Red cockaded woodpecker (*Picoides borealis*)	3.9 E	NA
Plant		
Snowy orchid (*Platanthera nivea*)	0.0	NA
Venus fly-trap (*Dionaea muscipula*)	0.05 S	0.1
Pondspice (*Listea aestivalis*)	0.25 N	NA
Tracy's beaksedge (*Rhynchospora tracyi*)	3.6 S	NA
Spoonflower (*Peltandra sagittifolia*)	3.4 W	NA

W = West
S = South
E = East
N = North
NA = Not Applicable
Source: Weston (1999).

Environmental media impacted by the site contaminants include soil, sediment and water. There are several pathways through which aquatic and terrestrial receptors may come into contact with the site contaminants. For example, contaminants in the soil may come in contact with subsurface (earthworms) and above-ground terrestrial receptors (small mammals) inhabiting the wooded and wetland areas of the site. Subsurface terrestrial receptors in these areas may be exposed to site contaminants through direct contact with the soil, and in some cases, the intentional ingestion of soil. Organisms at the site may come into contact with the site contaminants through direct contact with the media (i.e. soil, sediment and surface water) from water ingestion, soil ingestion, or secondarily through ingestion of contaminated prey. For aquatic organisms, direct contact with the sediment contaminants incorporates the adsorbed sediment to the solid phase as well as those dissolved in the water column and as particulates that may be ingested. The potential exposure pathways for contaminant exposure are presented in Table 31. These pathways are linear representations of complex interactions regarding dynamics of contaminant movement through the ecosystem.

Table 31 - Potential Pathways for Contaminant Exposure

Receptor	Exposure Routes	Assessment Endpoints	Measurement Endpoints
Soil Invertebrates	• Soil: direct contact, ingestion	Ensure that exposure to soil contaminants does not have adverse effects on survival, growth, and/or reproduction of soil-dwelling invertebrate community.	• Chemical analysis of the site soils • Earthworm, *Eisenia foetida*, acute toxicity and bioaccumulation tests • Soil benchmark values.
Insectivorous Mammal Populations	• Soil: direct contact, incidental ingestion • Water: direct contact, ingestion • Other: ingestion of soil invertebrates	Ensure that ingestion of site invertebrates by insectivorous mammals does not result in adverse effects on the survival, growth, and reproduction.	• Chemical analysis of the site soils • Earthworm, *E. foetida*, tissue data from 28-day bioaccumulation tests • Food web model
Omnivorous Bird Populations	• Soil: direct contact, incidental ingestion • Sediment: direct contact, incidental ingestion • Water: direct contact, ingestion • Other: ingestion of prey species	Ensure that ingestion of prey and incidental ingestion of contaminants in soil do not result in adverse effects on the survival, growth, and reproduction of Omnivorous Birds.	• Chemical analysis of the site soils • Earthworm, *E. foetida*, acute toxicity and bioaccumulation tests • Food web model
Carnivorous Bird Populations	• Soil: incidental ingestion • Water: direct contact, ingestion • Other: ingestion of small mammals	Ensure that ingestion of prey and incidental ingestion of contaminants in soil do not result in adverse effects on the survival, growth, and reproduction of Carnivorous Birds.	• Chemical analysis of the site soils • Earthworm, *E. foetida*, acute toxicity and bioaccumulation tests • Food web model
Insectivorous Bird Populations	• Sediment: direct contact, incidental ingestion • Water: direct contact, ingestion • Other: ingestion of insects of soil	Ensure that ingestion of contaminants in emergent aquatic invertebrates does not adversely impact the growth, reproduction, and survival of insectivorous birds.	• Chemical analysis of the site sediments • Aquatic worm tissue data using the oligochaete, *Lumbriculus variegatus* as a surrogate for emergent insects
Benthic Invertebrates	• Sediment: direct contact, ingestion • Water: direct contact	Ensure that contact with the site sediments does not negatively impact the growth, reproduction, and survival of the benthic macroinvertebrate communities.	• Chemical analysis of the site sediments • Aquatic invertebrate solid-phase sediment toxicity tests using the following freshwater species: the midge, *Chironomus tentans*, the amphipod, *Hyalella azteca*, and the oligochaete, *Lumbriculus variegatus* • Sediment benchmark values.
Fish Populations	• Sediment: direct contact, incidental ingestion • Water: direct contact, ingestion • Other: ingestion of prey species	Ensure that contact with the site sediments does not negatively impact the growth, reproduction, and survival of fish populations that inhabit the site.	• Chemical analysis of the site surface water and sediments

5 9 0053

Receptor	Exposure Routes	Assessment Endpoints	Measurement Endpoints
Omnivorous and Carnivorous Mammal Populations	• Sediment: direct contact, incidental ingestion • Water: direct contact, ingestion • Other: ingestion of benthic invertebrates and fish	Ensure that ingestion of contaminants in prey and incidental ingestion of contaminated abiotic media do not adversely impact the growth, reproduction, and survival of omnivorous and carnivorous mammals. Help define the potential risks from ingestion of contaminated prey and incidental ingestion of soil by omnivorous and carnivorous mammals.	• Chemical analysis of the site sediments • The oligochaete, *L. variegatus,* acute toxicity and bioaccumulation tests • Chemical analysis of the *Lumbriculus* tissue • Food web exposure model to estimate the exposure to the short-tailed shrew to estimate risks to omnivorous and carnivorous mammals
Piscivorous Bird Populations	• Sediment: direct contact, incidental ingestion • Water: direct contact, ingestion • Other: ingestion of prey species	Ensure that ingestion of site contaminants and incidental ingestion of contaminated abiotic media do not negatively impact the growth, reproduction, and survival of piscivorous birds.	Not evaluated (no fish were observed in either of the two ponds that contained surface water)
Reptile and Amphibian Populations	• Soil: direct contact, incidental ingestion • Sediment: direct contact, incidental ingestion • Water: direct contact, ingestion • Other: ingestion of prey	Ensure that ingestion of prey at the site does not result in any adverse effects on the survival, growth, and reproduction of reptiles and amphibians.	Not evaluated individually because mammals are more sensitive to chemical contaminants than reptiles. Therefore, if mammals are addressed, reptiles would also be addressed.

5 9 0054

2.7.2.3 Ecological Effects Assessment

In December 2001, personnel from EPA Region 4's Waste Division, SESD, and ILS went to the Site to collect soil, sediment and surface water samples to return to SESD's laboratory for analysis, toxicity testing, bioaccumulation testing, and food web modeling. Samples were obtained from the locations of the highest concentrations found previously at the Site and locations with data gaps (scrap copper area, drum disposal area, pipe shop area, south tank cradle area, ponds, Prince George Creek, background locations). Detrimental effects were shown in the samples taken from the scrap copper area, Pond 1 and Pond 4. The results of the toxicity testing are included in Tables 32 through 35.

Table 32 - Survival and Growth of *Eisenia foetida* After a 14-Day Exposure to Soil Samples

Sample ID	Location	Number Alive[a]	Percent Survival	Growth (%)
Control	Laboratory	39	98	8.8
RC-111-SS	Scrap copper area	29	73[b]	- 48[c]
RC-112-SS	Scrap copper area	39	98	0.59
RC-105-SS	Background	40	100	11.65
RC-126-SS	Drum disposal area	40	100	7.3
RC-140-SS	South tank cradle	40	100	8.99
RC-142-SS	South tank cradle	37	93	5.97
RC-185-SS	Pipe shop	40	100	6.15
RC-104-SS	Pond 4	40	100	- 1.5

Notes:
[a] Forty organisms were exposed per sample (ten organisms per replicate)
[b] Significantly different from laboratory control and background soils (p=0.05)
[c] Depression in weight of 20 percent or more is considered statistically significant

Table 33 - Survival of *Lumbriculus variegatus* After a 4-Day Exposure to Sediment Samples

Sample ID	Location	Number Alive[a]	Percent Survival	Continue with Test[b]?
Control		40	100	Yes
RC-105-SD	Background	40	100	Yes
RC-101-SD	Pond 1	0	0[c]	No

Notes:
[a] Forty organisms were exposed per sample (ten organisms per replicate)
[b] Decision to continue bioaccumulation tests was based on the 4-day screen survival. Since there was no survival, bioaccumulation testing could not be performed.
[c] Significantly different from the laboratory control and background sediments (p=0.05)

Table 34 - Survival and Growth of *Hyalella azteca* After a 10-Day Exposure to Sediment Samples

Sample ID	Location	Number Alive[a]	Percent Survival	Growth (mg)[b]
Control		80	100	NM
RC-105-SD	Background	79	99	NM
RC-101-SD	Pond 1	28	35[c]	NM
RC-104-SS**	Pond 4	20	25[c]	NM

Notes:
[a] Eighty organisms were exposed per sample (ten organisms per replicate)
[b] Growth was calculated based on the surviving number of organisms
[c] Significantly different from the laboratory control and background sediments (p=0.05)
** This sediment sample was labeled soil sample because the pond was dry
NM = Not measured

Table 35 - Survival and Growth of *Chironomus tentans* After a 10-Day Exposure to Sediment Samples

Sample ID	Location	Number Alive[a]	Percent Survival	Growth[b] (mg)
Control		67	84	NM
RC-105-SD	Background	67	84	NM
RC-101-SD	Pond 1	0	0[c]	NM
RC-104-SS**	Pond 4	0	0[c]	NM

Notes:
[a] Eighty organisms were exposed per sample (ten organisms per replicate)
[b] Growth was calculated based on the surviving number of organisms
[c] Significantly different from the laboratory control and background sediments (p=0.05)
** This sediment sample was labeled soil sample because the pond was dry
NM = Not measured

2.7.2.4 Ecological Risk Characterization

A summary of the ecological risks posed by the contaminated soils and sediments at the Site are found in Tables 36 and 37. When surface soils results were compared to literature values, the contaminants with hazard quotients greater than unity included copper, lead, zinc, total PAHs and dioxins/furans. Copper and lead were the only two contaminants of concern for surface soil utilizing site-specific toxicity testing and Food Web Modeling. For sediment, copper, VOCs and PAHs are the contaminants of concern.

Table 36 - Summary of Ecological Risks in Surface Soil

Assessment Endpoint	Lines of Evidence	COPCs Involved	Affected Locations
Protection of Soil Invertebrates	HQs greater than unity using mean and maximum exposure point concentrations	Copper, lead, zinc, total PAHs, and dioxins/furans	Copper: SCA, STC, PS Lead: SCA Zinc: PS Total PAHs: DD Dioxins/furans: SCA
	Site-specific toxicity tests showing acute toxicity in the soil samples with *Eisenia foetida*	Copper, lead	Copper: SCA Lead: SCA
Protection of Insectivorous Mammals	HQs from Food Web Model greater than one when compared with NOAEL and LOAEL TRVs	Copper, lead	Copper: SCA Lead: SCA
Protection of Omnivorous and Carnivorous Birds	HQs greater than unity using mean and maximum exposure point concentrations	Copper, lead, and zinc	Copper: SCA, STC, PS Lead: SCA Zinc: PS

Notes:
COPC = Chemical of Potential Concern
SCA = Scrap Copper Area
STC = South Tank Cradle Area
PS = Pipe Shop
DD = Drum Disposal Area
HQ = Hazard Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
TRV = Toxicity Reference Value

Table 37 - Summary of Ecological Risks in Sediment

Assessment Endpoint	Lines of Evidence	COPCs Involved	Affected Locations
Protection of Insectivorous Birds	HQs from Food Web Model greater than one when compared with NOAEL and LOAEL TRVs	Copper VOCs Total PAHs	Copper: Ponds 3 and 4 VOCs: Ponds 2, 3, and 4 Total PAHs: Pond 3
Protection of Benthic Macroinvertebrates	HQs greater than unity using mean and maximum exposure point concentrations	Copper VOCs Total PAHs	Copper: Ponds 3 and 4 VOCs: Ponds 2, 3, and 4 Total PAHs: Pond 3
	Site-specific toxicity tests showing acute toxicity in the sediment samples to *Chironomus tentans, Hyalella azteca,* and *Lumbriculus variegatus*	Copper VOCs Total PAHs	Copper: Ponds 1 and 4 VOCs: Pond 3 Ponds 1,2, and 4 Total PAHs: Pond 3

Notes:
COPC = Chemical of Potential Concern
VOC = Volatile Organic Compound
PAH = Polycyclic Aromatic Hydrocarbon
HQ = Hazard Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
TRV = Toxicity Reference Value

Because of limited site-specific data, protective levels could only be calculated for a few of the contaminants. That information follows:

Surface Soils

PAHs. Based on the data, an appropriate cleanup level from an ecological perspective for total PAHs in soils would be ~80,000 μg/kg. In the BERA, total PAHs were retained as COPCs based on a maximum total PAH concentration of 51,740 μg/kg, in the drum disposal area (RC-26-SS). In December 2001, the same location had a total PAH concentration of 79,560 μg/kg (RC-126-SS). There were no acute (% survival) or chronic (% growth) effects exhibited during toxicity testing of that sample. Since no toxicity was found at a total PAH concentration of 79,560 μ/kg, this value can be used as an ecological clean up value for site soils. Since this was the maximum concentration found at the Site, there are no soils that would need remediation based on total PAH concentrations.

Metals. For soil metals, the data does not show a well defined concentration gradient with corresponding effects. The sampling locations had either high or significantly lower concentrations. This made it difficult to develop protective levels. All effects were associated with a hot spot, the scrap copper area.

The only soil location that exhibited soil toxicity was sample RC-111-SS, a composite sample collected within the scrap copper area. The earthworm toxicity/bioaccumulation test results for this sample show a 73% survival rate at the end of 14 days of exposure and a 6% survival rate at the end of 28 days of exposure. Because of the low survival rate at the end of the 28-day test, there was not enough tissue available to perform bioaccumulation testing on that sample. A summary of the results of analysis for the scrap copper area are presented in Table 38.

Table 38 - Summary of Toxicity Test of *E. foetida* from the Scrap Copper Area

Sample ID	% Survival		% Growth at 14-days	Inorganics (mg/kg)			Organics (µg/kg)
	14-days	28-days		Copper	Lead	Zinc	Total PAHs
Control (laboratory)	98	93	8.8	NM	NM	NM	NM
RC-105-SS Background	98	88	11.65	13	330	240	376.8
RC-111-SS	73	6	-48	99000	2100	220	16722
RC-112-SS	98	91	0.59	2700	120	25	528.4

Notes:
PAHs = Polycyclic Aromatic Hydrocarbons
NM = Not Measured

Sample RC-112-SS was collected right next to the scrap copper area. The toxicity test results show no acute effect (survival) and only minor chronic effect (growth). This location had the second highest concentrations for copper and lead, but the values are significantly less than RC-111-SS. Trying to develop a protective level is very difficult because of the large difference in the metals concentrations between the two locations. A protective concentration may be somewhere between the two values. The data indicate that the concentrations detected in sample RC-112-SS are protective. Using RC-112-SS as a clean up criteria for copper, the only soils needing remediation for copper are located within the scrap copper area. Cleaning up the scrap copper area to contaminant levels found in the surrounding area would remove ecological risk posed by inorganics in surface soil.

Sediment

The sediments in Pond 1 are highly toxic. There was 0 % survival of chironomids (*Chironomus tentans*), 35 % survival of amphipods (*Hyalella azteca*), and 0 % survival of sediment worms (*Lumbriculus variegatus*). This is significant because sediment worms are hardy animals that generally survive long term toxicity tests and accumulate contaminants from the sediments.

Pond 2 was the least contaminated of the four ponds sampled during the December 2001 investigation. The sediments had elevated levels of VOCs, SVOCs and unidentified compounds, but the concentrations of the COCs were less than the Alternative Toxicity Values (HQ<1). RI sampling data from 1999, however, showed copper concentrations in slight excess of the Alternative Toxicity Values. No toxicity samples were collected at this location.

Because of the high levels of volatile compounds in the sediment of Pond 3, as indicated in analytical results and by field air monitoring, it was decided in the field not to collect a toxicity sample for this location.

Pond 4 is currently dry. When the sediments were treated as a soil sample, using toxicity testing animals generally used for soils (earthworms), there was no acute or chronic toxicity effects. However, the earthworms exhibited an avoidance behavior. When the sediments were treated as a sediment sample, using toxicity testing animals generally used for sediments, both test animals showed acute toxicity: 25% survival of amphipods and 0% survival of chironomids.

In summary, all four ponds (Ponds 1-4) have contaminated sediments. Ponds 1, 3, and 4 sediments are highly toxic and are unsuitable for sustaining an aquatic community. The data indicate the contaminated sediments in ponds 1-4 need to be remediated to eliminate ecological risks, however, clean up levels to protect ecological receptors can not be developed from the site-specific data currently available. A contaminant concentration gradient was not evident from samples collected during this December 2001 investigation. Sediment contaminant concentrations were either extremely high or low. This is not conducive for developing clean up levels.

The ponds are small, and under current conditions, do not and cannot support an aquatic ecosystem. Therefore, effective remediation would be to remove the contaminated sediments based on another type of clean up criteria, such as groundwater protection, and backfill the ponds. This would eliminate the exposure pathways for aquatic receptors.

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

2.8 Remedial Action Objectives

Remedial Action Objectives (RAOs) for the Reasor Chemical Company Site were developed from a review of the results of the site sampling data, site-specific risk and fate and transport evaluations, and review of ARARs. Operations conducted at the Site resulted in contamination of surface soils, sediments, surface water and potentially groundwater. The key COCs at the site include PAHs and metals. The clean-up goals were derived from predominantly the human health and ecological risk assessments, with some coming from ARARs. At the Site, the potential cancer and non-cancer risks to trespassers, potential future industrial workers and potential future residents exceeded the $1x10^{-6}$ and HQ=1 screening levels. Ecological risks were shown to be present in some of the surface soils and sediments through toxicity testing.

Under the NCP, EPA's goal is to reduce the excess cancer risk to the range of $1x10^{-4}$ to $1x10^{-6}$. For this Site, EPA is choosing the clean-up goals of $1x10^{-5}$ for carcinogenic compounds, HQ of 1 for most non-carcinogenic compounds, and other levels based on the ecological risk assessment (copper in soil), EPA guidance (lead in soil) and ARARs (thallium in groundwater and metals in surface water).

The soil RAOs are to prevent further migration of contaminants from soil to groundwater and surface water and to eliminate the unacceptable risk to human health and the environment from contaminated soil by attaining the human health and ecological risk based cleanup goals for the following contaminants of concern: benzo(a)pyrene, benzo(a)anthracene, benzo(b &/or k)fluoranthene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, Total PAHs, antimony, copper, and lead.

The sediment RAOs are to prevent further migration of contaminants from sediment to groundwater and surface water, and to eliminate exposure of ecological receptors to contaminated sediment by achieving ecological risk based sediment cleanup goals for the following contaminants of concern: methyl ethyl ketone, toluene, (3-and/or 4-)methylphenol, total PAHs, and copper.

The surface water RAOs are prevent further migration of contaminants to soil, groundwater and down-gradient surface water bodies, and to eliminate exposure to contaminated surface water by aquatic receptors by achieving the North Carolina Surface Water Quality Standards (NCAC Title 15A, Chapter 2, Subchapter 2L.0100 and 2L.0200) for the following contaminants of concern: copper, lead, iron and zinc.

The groundwater RAO is to restore groundwater to drinking water levels by attaining Federal Drinking Water or risk-based standards for the contaminants of concern: thallium (Federal Maximum Contaminant Levels (MCLs)) and aluminum (risk-based).

2.9 Description of Alternatives

Twelve alternatives were developed for detailed evaluation. Four alternatives were evaluated for the combined media of soil and sediment, four alternatives were evaluated for surface water, and four alternatives were evaluated for groundwater.

2.9.1 Description of Remedy Components

2.9.1.1 Soil and Sediment Alternatives

Alternative 1 - No Action

The No Action alternative was evaluated as a baseline option for comparison to the other alternatives. Under this alternative, no remedial action would be performed. Contaminated soils and sediments would be left in place and will continue to be a source for migration of the contaminants of concern into groundwater and surface water. Any reduction in soil or sediment contaminant concentrations would be due to natural dispersion, attenuation, and degradation processes.

Alternative 2 - Institutional Controls

No active remediation would be conducted under this alternative. Instead, institutional measures of deed recordations would be used to prevent/minimize human exposure to contaminated soil and sediment. EPA would work with the State of North Carolina to place notices on the property deed(s) which would state that soil and sediment contamination exists on the property and that if it is disturbed there is a strong possibility that human exposure may occur and environmental damage may spread. These recordations would remain in place unless or until soil and sediment quality was returned to contaminant concentrations that would allow unrestricted use. Five-year reviews will be conducted (as required by the NCP) to determine if contaminants that remain on-site are causing additional risk to human health or the environment.

Alternative 3 - Excavation and Off-site Disposal

This alternative consists of excavation of surface soil and sediment that exceed cleanup goals. Pond water would be removed and treated by surface water alternative 3 or 4 discussed in section 2.9.1.3 of this ROD. Excavated soil and sediment would be sampled and analyzed under the TCLP procedure to determine if it is a RCRA characteristic hazardous waste. It is anticipated that the results will show that it is not a hazardous waste. The excavated soil and sediment would then be transported to an off-site permitted facility for landfilling as a regulated "non-hazardous" solid waste. If the TCLP results indicate that the wastes are hazardous, they would be transported to an off-site permitted Subtitle C facility for treatment/disposal. Decaying drums in the drum disposal area will be disposed with soils and sediments. Based on the assumed areas of contamination (scrap copper area, pipe shop, drum disposal area, Ponds 1-4), the calculated volume of soil and sediment requiring remediation is approximately 1,600 cubic yards (see Table 45 in section 2.12.2.3 for details of volume estimates).

Prior to excavation and treatment, the following general site preparation would be necessary:

- Survey and mark the limits of the area to be excavated.
- Prepare an area for decontamination of excavation equipment. Construct a lined pad with curbs and sump for the collection of decontamination water. The wastewater would be stored and tested to determine final disposition.

Excavation would be performed with standard construction equipment consisting mainly of an excavator. Excavated materials would be placed on a lined staging area prior to loading in trucks for offsite disposal. Dust suppression by wetting the soil would be performed as necessary.

Trucks to transport soil to an approved disposal facility would enter designated areas of the site and would be directed to a specific loading area. Each truck must adhere to U.S. Department of Transportation (DOT) requirements and follow manifesting procedures.

After excavation, the areas will be backfilled with imported fill and graded to match the contour of the adjacent land. All disturbed areas would be revegetated with native plants or covered with crushed stone as appropriate.

Alternative 4 - Excavation and On-site Stabilization/Solidification

This alternative consists of excavation of contaminated surface soil and sediment that exceed cleanup goals. Pond water would be removed and treated by surface water alternative 3 or 4 discussed in section 2.9.1.3. Excavated soil and sediment would be stabilized using solidification technology to bind the contaminants within a stabilized mass. The resultant mass would be left on site.

Initially, a treatability study would be performed on the contaminated site soil and sediment to determine the appropriate mixtures of stabilizing agents. The most common stabilization process uses pozzolan/Portland cement consisting primarily of silicates from pozzolanic-based materials like fly ash or kiln dust. These materials chemically react with water to form a solid cementious matrix which improves the handling and physical characteristics of the waste. Pozzolanic and cement-based binding agents are typically appropriate for inorganic contaminants. The low levels of organics found in the soils should not interfere with this process. The process involves mixing the reagents with the contaminated soil using pug mils, ribbon blenders, extruders, or screw conveyors, depending of the vendor. The stabilized material would be placed on site in a designated area in 8 to 10-inch lifts not to exceed 2 feet in total thickness. It would then be covered.

Decaying drums from the drum disposal area will be combined with soils. Based on the assumed areas of contamination (scrap copper area, drum disposal area, pipe shop, Ponds 1-4), the calculated volume of soil is approximately 1,600 cubic yards (see Table 44 in section 2.12.2.3 for details of volume estimates). Assuming a 30% increase in volume due to the addition of reagents, a total of 2,080 cubic yards of stabilized material would be placed on site. At 2-feet thick, an area 170 feet by 170 feet (approximately 0.6 acres) would be required to accommodate the solidified material.

Prior to excavation and treatment, the following general site preparation would be necessary:

- Survey and mark the limits of the area to be excavated.
- Prepare an area for decontamination of excavation equipment. Construct a lined pad with curbs and sump for the collection of decontamination water. The wastewater would be stored and tested to determine final disposition
- Prepare a treatment pad area for the mixing process.

Excavation would be performed with standard construction equipment consisting mainly of an excavator. Excavated materials would be placed on a lined staging area prior to feeding into the mixing device. Stabilized material would be hauled directly into the designated placement area. Dust suppression by wetting the soil would be performed as necessary.

The areas requiring excavation would be backfilled with material excavated from the 1 acre designated placement area that will be excavated 2 feet below grade to allow the final grades to match the current contours of the adjacent undisturbed land. All areas disturbed by excavation will be revegetated with native plants or covered with crushed stone as appropriate. EPA would work with the state and local governments to apply land use restrictions to the portion of the property containing the stabilized wastes.

2.9.1.2 Groundwater Alternatives

<u>Alternative 1 - No Action</u>

Under the No Action alternative, no remedial actions would be implemented. Contaminated groundwater would be left in place without treatment allowing continued migration of the contaminants of concern. Any reduction in groundwater concentrations would be due to natural migration, dispersion, attenuation, and degradation processes.

<u>Alternative 2 - Institutional Controls with Monitoring</u>

No active remediation would be conducted under this alternative. Instead, institutional measures of deed recordations would be used to prevent/minimize exposure to contaminated groundwater.

EPA will work with the State of North Carolina to place notices on property deeds on-site and downgradient of the suspected source area which will state that groundwater contamination potentially exists on the property. These recordations will remain in place until the groundwater quality improves enough to allow for unrestricted use. Under this alternative, groundwater monitoring will take place annually at the existing on-site monitor wells and former production wells to determine the accuracy of previous data on groundwater contamination. In addition, five-year reviews will also be conducted to determine if contaminants that remain on-site are causing additional risk to human health or the environment. As a result of this review, EPA will determine if additional site remediation is required. Five-year reviews are assumed to be conducted for a 30-year period.

Alternative 3 - Groundwater Extraction and Treatment On-Site Using Chemical Precipitation

This alternative includes all the provisions of Groundwater Alternative 2 and adds remediation of the groundwater that contains contaminant concentrations above the remediation goals. Under this alternative, five extraction wells would be installed along the southeastern boundary of the site.

Initially, groundwater modeling would be used to model the groundwater recovery system. The FS assumed that the five extraction wells would generate 2 gallons per minute (gpm) per well for a total flow of 10 gpm.

The treatment system would be designed to handle the 10 gpm influent for treatment of inorganics. The proposed system would utilize chemical precipitation as the technology to treat the groundwater. Influent groundwater would first go into a holding tank. In-line static mixers would inject the proper chemicals to precipitate the metals. The precipitate will settle in the holding tank and the clarified water would be pumped through an automatic backwashing sand filter prior to discharge to the surrounding surface water (Prince George Creek) under an NPDES permit. The precipitates will be disposed of at an off-site RCRA permitted treatment/disposal facility.

Alternative 4 - Groundwater Extraction and Treatment Using Constructed Wetlands

The constructed wetland approach to treating the groundwater and surface runoff from the Site consists of the application of two separate but similar wetland systems. The constructed wetland approach is basically providing nature with the materials it needs to bind and stabilize the pollutants into the soil of a developing peat bog, true natural attenuation.

The groundwater treatment system consists of installing five extraction wells along the southeastern boundary of the site and pumping the extracted groundwater to a dual cell constructed wetland located at the site of the existing settling pond in the northeast corner of the property. Initially, groundwater modeling will be used to model the groundwater recovery system. The FS assumed that the extraction wells would generate 2 gallons per minute (gpm) per well for a total flow of 10 gpm. The existing settling pond would be modified to become two wetland treatment cells operating in series. Each cell would have a water depth of 12 inches and be planted with a bulrush species. The existing pond area can provide approximately 63 hours of hydraulic detention time at 10 gpm to permit biochemical removal of the majority of the aluminum and thallium present. The treated effluent of the wetland cells would be discharged to the drainage ditch on site and flow through the storm water treatment system that will treat surface storm water as described in Surface Water Alternative 4 in Section 2.9.1.3. The storm water treatment system is dependent on the effluent from the groundwater wetland system to maintain growth of the plants.

2.9.1.3 Surface water Alternatives

Alternative 1 - No Action

Under the No Action alternative, no remedial actions would be implemented. Contaminated surface water would be left in place as a source for migration of the contaminants of concern into groundwater and to Prince George Creek. Any reduction in contaminant concentrations in the surface water would be due to natural dispersion, attenuation, and degradation processes.

Alternative 2 - Institutional Controls with Monitoring

No active remediation would be conducted under this alternative. Instead, institutional measures of deed recordations would be used to prevent/minimize human exposure to contaminated surface water.

EPA will work with the State of North Carolina to place notices on the property deed(s) which will state that surface water contamination exists on the property. These recordations will remain in place until the surface water quality improves enough to allow for unrestricted use. Deed recordations would be established for the site to prohibit development and exposure to contaminated surface water. These recordations would remain in place until the surface water quality improved enough to allow for unrestricted use (unlikely without active remediation). Under this alternative, surface water monitoring will take place annually at the 4 existing ponds and 2 wetland locations to the south and east of the site. In addition, five-year reviews will also be conducted to determine if contaminants that remain on-site are causing additional risk to human health or the environment.

Alternative 3 - Off-site Treatment/Disposal

This alternative consists of removal of surface water located in the four manmade ponds which have contaminant concentrations exceeding State surface water criteria. In order to be effective, this alternative would be implemented in conjunction with soil and sediment Alternative 3 or 4, which would remove the sediment and prevent further contamination of accumulated surface water in the ponds.

Surface water would be extracted from the ponds using a vacuum tanker truck and transported to an off-site facility for treatment. Prior to removal, samples would be collected and analyzed for waste profiling that will determined the final treatment method. The treatment facility will have the RCRA permits to accept and treat contaminated materials. The transporter will also be required to follow proper manifesting procedures as determined by the waste characterization analysis.

For estimating purposes, it was assumed that the depth of water in each pond is 4 feet. Pond 4 has been observed to be dry during past investigations; however, this may be affected by seasonal rainfall and will be conservatively estimated with 4 feet of water. This results in an estimated 526,592 gallons of contaminated surface water (see Table 44 in section 2.12.2.2 for breakdown).

Trucks to transport the water to an approved treatment and disposal facility will enter designated areas of the site and will be directed to a specific loading area. Each truck must adhere to U.S. DOT requirements for general bulk transportation and will follow manifesting procedures.

Alternative 4 - On-Site Treatment Through Constructed Wetlands Treatment

This alternative consists of removal of the surface water from the ponds and storage in temporary tanks on site for treatment through constructed wetlands. It also includes the collection of stormwater flowing over the site followed by treatment through the constructed wetlands. This alternative can only be used in conjunction with Groundwater Alternative 4.

The constructed wetland approach to treating the groundwater and surface runoff consists of the application of two separate but similar wetland systems. The constructed wetland approach is basically providing nature with the materials it needs to bind and stabilize the pollutants into the soil of a developing peat bog, true natural attenuation.

The storm water treatment system consists of a detention pond sized to hold the first inch of runoff based on a 1 year-24 hour storm of 3.7 inches and would normally flow to two additional wetland cells to remove metals. The volume of flow to the wetlands would be controlled. Whenever the storm water flow exceeded the capabilities of the wetland it would be discharged to the Prince George Creek through an overflow structure with the stream banks lined with riprap for erosion protection. The wetland cells would also operate in series, be designed for a 12 inch water depth, and be planted with a species of bulrush. The two cells, each 75 feet by 300 feet, would provide for about 25 hours of detention time to remove the majority of metal contaminants from the flow generated by a 1 year-24 hour (3.7 inches) storm event. The effluent from the wetland cells would be discharged to Prince George Creek. The effluent from the extraction groundwater treatment will keep the second set of wetlands moist during periods of low rainfall and high evaporation.

Table 39 - Remedial Alternatives

Medium	Designation	Description
Soil and Sediment	S1	No Action
	S2	Institutional Controls
	S3	Excavation and Off-Site Disposal
	S4	Excavation and On-Site Stabilization/Solidification
Groundwater	G1	No Action
	G2	Institutional Controls with Monitoring
	G3	Extraction and Treatment Using Chemical Precipitation
	G4	Extraction and Treatment Using Constructed Wetlands
Surface Water	SW1	No Action
	SW2	Institutional Controls with Monitoring
	SW3	Off-Site Treatment/Disposal
	SW4	On-Site Treatment through Constructed Wetlands

2.9.2 Common Elements and Distinguishing Features of Each Alternative

Alternative 1 for each of the media (soil and sediment, groundwater, and surface water), is the No Action alternative. This alternative includes the 5-year review which would be required if this alternative is chosen.

Alternative 2 for each of the media is Institutional Controls with monitoring for surface water and groundwater. The monitoring would be conducted annually, in addition to a 5-Year Review.

Alternatives 3 and 4 for **soil and sediment** include the common element of excavation. The disposal and/or treatment varies between the two, but the clean-up levels are the same. Both would require selecting surface water alternative 3 or 4. The primary difference between the two are on-site treatment versus off-site disposal, costs and requirement of a five-year review.

Alternatives 3 and 4 for **groundwater** would both require installing extraction wells and pumping the water from the aquifer until the groundwater clean-up goals are achieved. The treatment method varies, but both methods would achieve the standards required for discharge of the treated water.

Alternatives 3 and 4 for **surface water** would require the pumping of the surface water and transference to either the treatment unit or trucks. The treatment location and methods vary, but both methods would achieve the standards required for discharge of the treated water.

2.9.3 Expected Outcomes of Each Alternative

All No Action alternatives would leave the site as presenting the same risks as are currently present. It would not allow the land to be used without restrictions. Contamination migration would be expected to continue.

2.9.3.1 Soil and Sediment Alternatives

Alternative 2, Institutional Controls, may reduce the risks to human receptors but would require restrictions on land use. It only reduces the risks if enforced. There are currently trespassers utilizing the property. It is doubtful that placing deed recordations would eliminate current trespassers from utilizing the property. It may, however, deter development of the property. This alternatives would not reduce the risk to ecological receptors. Contamination migration would be expected to continue.

Alternative 3, Excavation and Off-Site Disposal, would return the Site to unrestricted/unconditional use for the soil media. The risks to human and ecological receptors would be reduced to acceptable levels.

Alternative 4, Excavation and On-site Stabilization, would reduce the risks to human and ecological receptors to acceptable uses. However, because stabilized wastes would remain on-site, land use restrictions would be required for the portion of the property containing the stabilized mass.

2.9.3.2 Groundwater Alternatives

Alternative 2, Institutional Controls with Monitoring, would deter future use of the groundwater for drinking purposes. Since there are no current groundwater uses at the Site, this alternative would reduce the risks to human receptors.

Alternative 3, Extraction and Treatment Using Chemical Precipitation, would deter future use of the groundwater for drinking water purposes. It would also treat the contaminated groundwater to acceptable levels for discharge to the nearby creek. It is estimated to take many decades to return the water to unrestricted use designation.

Alternative 4, Extraction and Treatment Using Constructed Wetlands, would provide the same expected outcome of Groundwater Alternative 3. This alternative would also provide an additional ecological habitat by constructing a wetlands on-site. The operation and maintenance is also expected to be less involved than with Groundwater Alternative 3.

2.9.3.3 Surface Water Alternatives

Alternative 2, Institutional Controls with Monitoring, may reduce the risks to human receptors but would require restrictions on land use. It only reduces the risks if enforced. There are currently trespassers utilizing the property. It is doubtful that placing deed recordations would eliminate current trespassers from utilizing the property. It may, however, deter development of the property. This alternatives would not reduce the risk to ecological receptors. Contamination migration would be expected to continue.

Alternative 3, Off-site Treatment/Disposal, would return the Site to unrestricted/unconditional use for the surface water media only if used in conjunction with either Soil and Sediment Alternatives 3 or 4. The risks from surface water to human and ecological receptors would be reduced to acceptable levels.

Alternative 4, On-Site Treatment through Constructed Wetlands, would treat the contaminated surface water to acceptable levels for discharge to the nearby creek. It would return the Site to unrestricted/unconditional use for the surface water media only if used in conjunction with either Soil and Sediment Alternatives 3 or 4. This alternative is only cost effective if used in conjunction with Groundwater Alternative 4.

2.10 Comparative Analysis of Alternatives

In this section, each alternative is evaluated using the nine evaluation criteria required in Section 300.430(f)(5)(i) of the NCP. Table 43, located at the end of section 2.10, provides a summary of the information that follows.

2.10.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

For each of the media, all of the alternatives, except the no-action alternative, are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the site through treatment of soil contaminants, engineering controls, and/or institutional controls. Alternative 2 would reduce the risk to human health. However, only Alternatives 3 and 4 would significantly reduce the risk to both human health and the environment, and allow unrestricted use once the remediation is completed. Since the no-action alternative will not provide protection, it will not be discussed below. They are discussed in order of most protective to least protective for each media.

2.10.1.1 Soil and Sediment Alternatives

Alternative 3 would reduce or eliminate the risk of direct exposure to contaminants in soils and sediments by potential human and ecological receptors. The contaminated soil and sediments would be removed from the site and therefore would not be available for exposure or leaching to groundwater.

Alternative 4 would reduce or eliminate the risk of direct exposure to contaminants in soils and sediments by potential human and ecological receptors. The contaminated soil and sediments would be stabilized and left on-site and reducing the potential for exposure or leaching to groundwater.

Alternative 2 would reduce the risk of direct exposure to contaminants in soils and sediments by potential human receptors. Since the contaminated soils and sediments would remain on-site, untreated, it would not reduce the risks to ecological receptors. The contamination would potentially continue to migrate off-site to nearby wetlands and Prince George Creek. The contamination would potentially continue to leach to groundwater.

2.10.1.2 Groundwater Alternatives

Alternative 4 would provide significant protection of human health and the environment. The contaminated groundwater would be extracted from the aquifer and pumped through a constructed wetlands system to capture the metals. The water leaving the constructed wetlands would be of acceptable quality for discharge to tributaries to Prince George Creek. This alternative adds an extra layer of environmental protection by the construction of additional wetlands on-site, which would provide habitats for ecological receptors.

Alternative 3 would provide significant protection of human health and the environment. The contaminated groundwater would be extracted from the aquifer and pumped through a chemical precipitation system to capture the metals. The water leaving the treatment system would be of acceptable quality for discharge to tributaries to Prince George Creek.

Alternative 2 would provide protection of human health through the use of deed recordations, alerting potential purchasers of the potential hazards associated with contaminated groundwater. There are currently no on-site groundwater users and there are questions about some of the groundwater data (possible overestimation of concentrations). Long-term groundwater monitoring would be used to monitor changes in groundwater contamination.

2.10.1.3 Surface Water Alternatives

Alternative 3 would reduce or eliminate the risk of direct exposure to contaminants in surface water by potential human and ecological receptors. The contaminated water would be removed from the property and therefore, would not be available for exposure or leaching to groundwater. This alternative is only effective if used in conjunction with Soil and Sediment Alternatives 3 or 4. Unless the contaminated sediment is removed, removal of ponded surface water would only result in eventual contamination of rain water that would later fill the contaminated ponds.

Alternative 4 would reduce or eliminate the risk of direct exposure to contaminants in surface water by potential human and ecological receptors. The contaminated surface water would be directed through the wetlands and treated before discharge. This alternative is only effective if used in conjunction with Soil and Sediment Alternatives 3 or 4. Unless the contaminated sediment is removed, removal of ponded surface water would only result in eventual contamination of rain water that would later fill the contaminated ponds.

Alternative 2 would reduce the risk of direct exposure to contaminants in surface water by potential human receptors through the use of deed recordations. However, it would not reduce the risk to ecological receptors. The contamination would potentially continue to migrate off-site to nearby wetlands and the Prince George Creek, and also potentially to groundwater.

2.10.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations, which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking waiver. For additional information on ARARs for this site, see section 2.13, Table 52 ARARs Attainment.

2.10.2.1 Soil and Sediment Alternatives

There are potential location-specific ARARs dealing with wetlands and floodplains, but the remediation is not expected to impact those designated areas of the Site. There are no chemical-specific ARARs for contaminated soils and sediments. There are chemical-specific State guidelines that are To Be Considered: North Carolina's Inactive Hazardous Sites Response Act of 1987 (North Carolina General Statute 130A-310 *et. seq.*), the associated *Guidelines for Assessment and Cleanup* (NC DENR), Inactive Hazardous Sites Program, 2001) and the soil/sediment remediation requirements detailed in Section 4 of the *Guidelines*. Alternatives 3 and 4 would achieve the soil/sediment remediation requirements of the ARAR, whereas Alternatives 1 and 2 would not.

There are several action-specific ARARs for soil and sediment. All soil and sediment alternatives will attain Federal and State action-specific ARARs. Alternatives 3 and 4 would both require compliance with OSHA standards, 29 CFR Part 1910, regarding worker safety. Alternative 3 would require compliance with RCRA standards, 40 CFR Parts 262 and 263, regarding generation and transportation of hazardous wastes. Alternative 3 would also require compliance with the Hazardous Materials Transportation Act, 49 U.S.C. §§ 1801-1813, 49 CFR Parts 107, 171-177, regarding transportation of DOT-defined hazardous materials. Alternatives 3 and 4 would also require compliance with NC Hazardous Waste Management Rules, NCAC Title 15A Subchapter 13A; regulations dealing with management of hazardous materials; NC Solid Waste Management Rules, NCAC Title 15A Subchapter 13B; regulations mandated to control flow and handling of solid waste materials; and, NC Erosion and Sediment Control Rules, NCAC Title 15A Subchapter 4B. Alternative 1, No Action, and Alternative 2, Institutional Controls, have no action-specific ARARs since there are no remedial actions associated with these alternatives.

2.10.2.2 Groundwater Alternatives

There are potential action-specific and chemical-specific ARARs for contaminated groundwater. There are also potential location-specific ARARs dealing with wetlands and flood plains, but the remediation is not expected to impact those designated areas of the Site and therefore not relevant. All groundwater alternatives will attain action-specific Federal and State ARARs.

The chemical-specific ARARs are potentially applicable because they are geared towards public drinking water systems which supply water to at least 25 people. The groundwater at this Site is not currently utilized by a public supply system. The potential chemical-specific ARARS include:

- Safe Drinking Water Act, 40 CFR Part 141: National Primary Drinking Water Standards
- NC Drinking Water and Groundwater Standards; NCAC Title 15, Chapter 2, Subchapter 2L.0200 and 0.0201, Groundwater Classifications and Standards

It is anticipated that both groundwater treatment alternatives will require the installation of extraction wells and will discharge to tributaries to Prince George Creek. The action-specific ARARs include:

- 33 U.S.C. §1342, Clean Water Act (CWA) Part 402, 40 CFR Part 122, NPDES requirements
- 33 U.S.C. §1311, CWA Part 301(b), Technology-based effluent limitations
- 29 U.S.C. §§ 651-678, OSHA, 29 CFR Part 1910, Safety of Workers
- NC Water Pollution Control Regulations, NCAC Title 15A Subchapter 2H, Procedures for Permits: Approvals, Point Source Discharges to the Surface Waters
- NC Water Pollution Control Regulations, NCAC Title 15A Subchapter 2B, Classification and Water Quality Standards Applicable to the Surface Waters and Wetlands of North Carolina
- Well Construction Standards, NCAC Title 15A Subchapter 2C.0100, Criteria and Standards Applicable to Water-Supply and Certain Other Type Wells
- NC Sedimentation Control Rules, NCAC Title 15A Subchapter 4B, Erosion and Sediment Control

Alternatives 3 and 4 will treat groundwater such that the contaminant concentrations in the effluent will be below remediation goals. These treatment options will comply with location- and action-specific ARARs and, decades into the future, may comply with chemical-specific ARARs.

Alternative 2 will not meet potential chemical-specific ARARs. Contaminants of concern in groundwater will remain in groundwater above the chemical-specific ARARs for an indefinite period of time. However, concentrations may decrease with time due to natural attenuation or through improved sampling and analysis techniques. This alternative will comply with location- and action-specific ARARs during the installation of the additional monitoring wells and during the sampling of the wells.

Alternative 1 will not meet potential chemical-specific ARARs. Contaminants of concern in groundwater will remain in groundwater above the chemical-specific ARARs for an indefinite period of time. However, concentrations may decrease with time due to natural attenuation or through improved sampling and analysis techniques. Location- and action-specific ARARs are not applicable, because there are no remedial actions associated with this alternative.

2.10.2.3 Surface Water Alternatives

There are action-specific and chemical-specific ARARs for contaminated surface water. There are potential location-specific ARARs dealing with wetlands and flood plains, but the remediation is not expected to impact those designated areas of the Site.

The chemical-specific ARARs for surface water include:

- 33 U.S.C. §1313, CWA Part 303, 40 CFR Part 131, Water quality criteria
- NC Water Pollution Control Regulations, NCAC Title 15A Subchapter 2B, Classification and Water Quality Standards Applicable to the Surface Waters and Wetlands of North Carolina

The action-specific ARARs for surface water include:

- RCRA, 40 CFR Part 262, Requirements for hazardous waste generators (Alternative 3)
- RCRA, 40 CFR Part 263, Requirements for hazardous waste transporters (Alternative 3)
- 33 U.S.C. §1342, CWA Part 402, 40 CFR Part 122, NPDES requirements (Alternative 4, On-Site Treatment through Constructed Wetlands)
- 33 U.S.C. §1311, CWA Part 301(b), Technology-based effluent limitations
- 29 U.S.C. §§ 651-678, OSHA, 29 CFR Part 1910, Safety of Workers
- 49 U.S.C. §§1801-1813, Hazardous Materials Transportation Act, 49 CFR Parts 107, 171-177, Regulates transportation of DOT-defined hazardous materials (Alternative 3)
- NC Water Pollution Control Regulations, NCAC Title 15A Subchapter 2H, Procedures for Permits: Approvals, Point Source Discharges to the Surface Waters

Alternatives 3 and 4 would comply with all chemical-specific, location-specific and action specific ARARs. Alternatives 1 and 2 would not meet chemical-specific ARARs. Location-specific and action-specific ARARs are not applicable to Alternatives 1 and 2 because there are no remedial actions associated with these alternatives.

2.10.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls. Each alternative, except the No Action alternative, provides some degree of long-term protection. Because Alternative 1, No Action, for each media does not provide for long-term effectiveness to either human or ecological receptors, it will not be discussed in the following subsections. The remainder of the alternatives are discussed in order of most effective/permanent to least effective/permanent for each media.

2.10.3.1 Soil and Sediment Alternatives

Alternative 3 would effectively reduce the risk to human and ecological receptors by permanently removing the contaminated soils and sediments.

Alternative 4 would also effectively reduce the risk to human and ecological receptors. The long-term stability of the treated material is dependent on the soil matrix and the type of reagents used. Since the soil contaminants remain on site, although stabilized, five-year reviews would be conducted to evaluate the effectiveness.

Alternative 2 would in a limited sense reduce the risk to human receptors. It would not provide any reduced risk to ecological receptors. Deed recordations, if properly implemented, would make nearby residents and potential purchasers aware of the contamination and thus prevent ingestion and direct contact with contaminated soil and sediments. Any reduction in concentrations in the long-term will be due to natural dispersion, attenuation, and degradation processes. It is doubtful that remedial action objectives can be met through natural processes in the foreseeable future; therefore, the chemical concentrations remaining at the site after many years may continue to leach contaminants into the groundwater.

2.10.3.2 Groundwater Alternatives

Alternatives 3 and 4 would provide permanent and effective treatment of the contaminants in groundwater. Long-term effectiveness is dependent upon the continued operation and consistent operation and maintenance of the system.

Alternative 2 would make residents and potential purchasers aware of the contamination and thus potentially prevent ingestion and direct contact with contaminated groundwater, thereby reducing risk. The long-term monitoring results and the actual effectiveness of the deed recordations would require periodic reassessment. There may be a remaining risk associated with future potential groundwater use for an extended period of time.

2.10.3.3 Surface Water Alternatives

Alternative 3 would permanently remove the contaminants from the site which would effectively reduce the risk to human and ecological receptors. The removal of the contaminants is permanent and irreversible.

Alternative 4 would treat the contaminated water and would effectively reduce the risk to human and ecological receptors. The contaminants would be bound in the constructed wetland system, making them unavailable to human or ecological receptors.

Alternative 2 would in a limited sense reduce the risk to human receptors. It would not provide any reduced risk to ecological receptors. Properly implemented deed recordations would make residents aware of the contamination and thus potentially prevent ingestion and direct contact with contaminated surface water. The long-term monitoring results and the actual effectiveness of the deed recordations would require periodic reassessment.

2.10.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Alternatives 1 and 2 do not include treatment as a component of the remedy. Therefore, these alternatives would not reduce the toxicity, mobility, or volume of contamination at the site. The remainder of the alternatives are discussed below.

2.10.4.1 Soil and Sediment Alternatives

Alternative 4 includes treatment of the principal threats, which reduces the mobility of the contaminants. Binding the contaminants in a stabilized mass results in reduced toxicity to receptors. Using binding agents increases the volume. Alternative 3 is not an active treatment method, but addresses the principal threats by removing the source. A significant reduction in toxicity, mobility, and volume of contaminants at the Site would occur under Alternative 3.

2.10.4.2 Groundwater Alternatives

Alternatives 3 and 4 would both reduce the toxicity, mobility and volume through treatment. It is expected that both alternatives would provide the same amount of reduction in toxicity, mobility and volume.

2.10.4.3 Surface Water Alternatives

Alternatives 3 and 4 would both reduce the toxicity, mobility and volume through treatment. It is expected that both alternatives would provide the same amount of reduction in toxicity, mobility and volume. However, the contaminants would be bound on-site using Alternative 4, and disposed elsewhere using Alternative 3.

2.10.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved. Alternatives 1 and 2, No Action and Institutional Controls for all media, do not include active remediation measures, and therefore, are not discussed the following subsections. The remainder of the alternatives are discussed in order of most effective to least effective for each media.

2.10.5.1 Soil and Sediment Alternatives

Alternative 3 is the active remediation soil and sediment alternative that will be completed in the shortest time period and would have limited impact to workers or the community. The primary adverse impacts during the implementation of this alternative include: dust created during the actual excavation, soil erosion, and truck traffic through the community. All of these potential risks can be addressed. The dust can be controlled with water sprays on-site while an air-monitoring program is implemented to detect any trace levels of contaminants in the air. Soil erosion can be controlled with silt fences placed in downgradient areas. To prevent any contamination from being spread by trucks, a decontamination area will be constructed and the trucks will be decontaminated prior to departing the site. Only OSHA trained personnel will be allowed to perform activities at the site during remedial activities. A site-specific health and safety plan will be developed and implemented outlining all the physical and chemical hazards associated with the site. This plan will also present the appropriate personal protective equipment necessary to safely perform each job function during the remediation work. The total time for excavation and transportation is estimated to be 20 working days excluding mobilization/demobilization and inclement weather days.

Alternative 4 would take slightly longer to implement than Alternative 3, but would have less of an impact to the community. The primary adverse impacts during the implementation of this alternative include: dust created during the excavation and stabilization process and soil erosion. These potential risks and worker safety can be addressed during planning and implementation as described in the preceding paragraph.

2.10.5.2 Groundwater Alternatives

Alternatives 3 and 4 would both provide short-term effectiveness. During installation of the extraction wells and water treatment system, the usual precautions necessary for construction activities will be taken. The installation of wells and the treatment system will not involve a significant release of volatiles to the environment. Disposal of any wastes generated during construction and operation would follow established handling practices. Alternative 4 is expected to take approximately 1 month longer to complete construction than Alternative 3.

2.10.5.3 Surface Water Alternatives

Alternative 3 is the surface water alternative that would take the least amount of time to implement. During the implementation of this alternative, dust created during the hauling, soil erosion, worker safety and truck traffic through the community will be controlled as described in section 2.10.5.1.

Alternative 4 would take approximately 3 months longer to implement than Alternative 3. During the installation of the wetlands, dust created during construction activities, soil erosion, and worker be controlled as described in section 2.10.5.1. Disposal of any wastes generated during construction and operation would follow established handling practices.

2.10.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. Alternative 1, No Action, for all media would be the most easily implemented alternative, because it does not require any present or future efforts. Alternative 2, Institutional Controls, for soil and sediment and surface water would require the cooperation of the State and local governments. The recordation is subject to loss during future property transfers. In addition, the deed recordations may be subject to change in legal and political interpretation over time. The remainder of the alternatives are discussed below in order of most implementable to least implementable.

2.10.6.1 Soil and Sediment Alternatives

Alternative 3 can be readily implemented with conventional construction and excavation equipment. Since the soil and sediments are not expected to be classified or listed as RCRA wastes, they do not fall under the land disposal restrictions and can be directly landfilled into a Subtitle D Landfill.

Alternative 4 has been used on CERCLA sites and is a proven technology. Excavation and backfilling is accomplished using standard earthwork equipment and several vendors are available with the mixing equipment.

2.10.6.2 Groundwater Alternatives

Alternative 3 involves installation of groundwater extraction wells, small pumps, air compressor, sand filter, and piping. These components are widely available and the system can be assembled using common construction techniques. All of the treatment system components are easily transported and installed.

Alternative 4 is a simple construction project. The construction should be scheduled to be completed and the wetland species planted in late April or May. The system will begin effective removal of pollutants immediately but will not be fully effective until the end of the second summer when the plants are mature. Construction of the proposed facilities would require dewatering the existing settling pond, demolishing the remains of the boiler house and concrete pad on the eastern portion of the site, bypassing the surface runoff through a temporary pipe to the east, excavating the detention pond and storm water cells, using the excavated soil for fill in the settling pond/groundwater cells, installing the necessary piping and hydraulic structures, installing the extraction wells and pumping system and final grading and grassing for erosion prevention. The hydrosoil would be designed, for example: soils selected from what is available and supplemented with fertilizer for the plants, organics as a carbon source, and materials to drive the biochemical reactions desired. Gypsum, for example, could be added to the hydrosoil to provide sulfides to react with and bind the copper and iron in the storm water.

Alternative 2 would require the cooperation of the State and local governments. The recordation is subject to loss during future property transfers. In addition, the deed recordations may be subject to change in legal and political interpretations over time. The monitor wells and production wells to be sampled are already in place.

2.10.6.3 Surface Water Alternatives

Alternative 3 can be readily implemented with conventional construction and vacuum tanker equipment. Proper manifesting and truck transportation requirements must be maintained and documented. The disposal facility has the capacity to accept the volume of surface water that could be removed daily.

Alternative 4 is a simple construction project. It has the same implementability issues as described for the groundwater Alternative 4 in section 2.10.6.2. Because of water needed to maintain a wetland environment, this surface water alternative can only be implemented if groundwater Alternative 4 is implemented.

2.10.7 Cost

The estimated present worth costs for the alternatives, are presented in the following subsections.

2.10.7.1 Soil and Sediment Alternatives

Table 40 - Soil and Sediment Alternatives' Cost Summary

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Capital Costs	$0	$5,000	$114,860	$338,200
5-Year Review	$8,000	$8,000	$0	$8,000
Admin. & Contingency	$3,200	$5,200	$51,687	$152,190
Total Present Worth Cost	$52,207.68	$84,837.48	$166,547	$527,681.20

The Soil and Sediment alternatives range in Total Present Worth Costs from $52,208 to $527,681. Five-year review costs are included in all of the alternatives except for Alternative 3, Excavation and Off-Site Disposal. The least expensive alternative is Alternative 1, No Action. Of the two active remediation alternatives, Alternative 3, Excavation and Off-site Disposal, is significantly less expensive than Alternative 4, Excavation and On-site Stabilization. The small volume of contaminated soil and sediment makes on-site treatment not very cost effective.

2.10.7.2 Groundwater Alternatives

Table 41 - Groundwater Alternatives' Cost Summary

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Capital Costs	$0	$5,000	$174,000	$351,500
Annual O&M	$0	$26,100	$111,160	$64,960
5-Year Review	$34,100	$8,000	$10,000	$10,000
Admin. & Contingency	$13,640	$12,440	$69,600	$140,600
Total Present Worth Cost	$222,535.24	$921,829.92	$2,593,405.98	$1,884,659.94
Note: Total Present Worth O&M Cost assumes a 1.5% discount rate				

The Groundwater alternatives range in Total Present Worth Costs from $222,535 to $2,593,406. The least expensive alternative is Alternative 1, No Action. Of the two active remediation alternatives, Alternative 4, Extraction and Treatment through Constructed Wetlands, is significantly less expensive than Alternative 3, Extraction and Treatment using Chemical Precipitation. The capital costs of Alternative 4 are greater than the capital costs of Alternative 3, but the decreased costs of annual operation and maintenance results in a lower total present worth cost for Alternative 4.

2.10.7.3 Surface Water Alternatives

Table 42 - Surface Water Alternatives' Cost Summary

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Capital Costs	$0	$5,000	$117,800	*Included in Groundwater Alternative 4 Costs*
Annual O&M	$0	$11,400	$0	
5-Year Review	$19,400	$8,000	$0	
Admin & Contingency	$4,560	$6,560	$53,010	
Total Present Worth Cost	$74,395.94	$427,583.97	$170,810	*$1,884,659.94*

The Surface Water alternatives range in Total Present Worth Costs from $74,396 to $1,884,660 (maximum costs is cumulative cost for groundwater and surface water remediation). The least expensive alternative is Alternative 1, No Action. Of the two active remediation alternatives, Alternative 4, Extraction and Treatment through Constructed Wetlands, is less expensive than Alternative 3, Extraction and Off-site Treatment and Disposal, if it is performed in conjunction with Groundwater Alternative 4 (resulting in zero cost). Alternative 3 is less expensive than Alternative 2, Institutional Controls.

2.10.8 State/Support Agency Acceptance

The State has expressed support for Soil and Sediment Alternatives 3 and 4, Groundwater Alternatives 2, 3 and 4, and Surface Water Alternatives 3 and 4. The State does not believe that Alternative 1 for each media and Alternative 2 for Soil, Sediment and Surface water provide adequate protection of human health and the environment.

2.10.9 Community Acceptance

Because no written comments were received on the Proposed Plan, and only a few comments were provided in the public meeting, it is difficult to determine community acceptance of the alternatives. At the public meeting, one person recommended utilizing Institutional Controls to limit expenditures and reduce human health risks. There were no vocalized objections to any of the alternatives. Of those comments expressed, most were related to costs. A few present thought that the alternative chosen should be the least expensive method to protect the community.

Table 43 - Comparative Analysis of Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls, Monitoring	Alternative 3 Soil/Sediment: Excavation and Off-site Disposal Surface water: Off-site Treatment and Disposal Groundwater: Extraction, Chemical Precipitation	Alternative 4 Soil/Sediment: Excavation and On-site Stabilization Water: Extraction, Constructed Wetlands
OVERALL PROTECTIVENESS				
Human Health Protection • Direct Contact/Soil Ingestion	• No Risk Reduction	• Minimal risk reduction, only to the extent ICs are enforced.	• Risks reduced to unrestricted land use.	• Risks reduced to restricted land use.
• Groundwater Ingestion for Current Users	• No current users	• No current users	• No current users	• No current users
• Groundwater Ingestion for Potential Future Users	• No Risk Reduction	• Risks are reduced to the extent that ICs are enforced.	• Risks reduced to MCLs once remediation is completed.	• Risks reduced to MCLs once remediation is completed.
Environmental Protection	No Risk Reduction	No Risk Reduction	Risks reduced to levels protective of ecological receptors	Risks reduced to levels protective of ecological receptors. Also provides new ecological habitats.
COMPLIANCE WITH ARARS				
Chemical Specific • Soil/Sediment	• No Chemical Specific ARARS	• No Chemical Specific ARARS	• No Chemical Specific ARARS	• No Chemical Specific ARARS
• Surface Water	• Contaminants will exceed surface water standards	• Contaminants will exceed surface water standards	• Contaminated water would be removed	• Contaminated water would be treated to meet ARARS
• Groundwater	• Contaminants will exceed drinking water standards	• Contaminants may exceed drinking water standards	• Groundwater would achieve drinking water standards in ~30 years	• Groundwater would achieve drinking water standards in ~30 years
Location Specific	Not Applicable	Would comply with wetlands and floodplain ARARS	Would comply with wetlands and floodplain ARARS	Would comply with wetlands and floodplain ARARS
Action Specific • Soil/Sediment	• Not Applicable	• Not Applicable	• Would comply with Action specific ARARS	• Would comply with Action specific ARARS
• Surface Water	• Not Applicable	• Would comply with Action specific ARARS	• Would comply with Action specific ARARS	• Would comply with Action specific ARARS
• Groundwater	• Not Applicable	• Would comply with Action specific ARARS	• Would comply with Action specific ARARS	• Would comply with Action specific ARARS
Other Criteria and Guidance	Contaminants will exceed health and ecological based clean-up goals	Contaminants will exceed health and ecological based clean-up goals	Would reduce both the human health and ecological risks to acceptable levels	Would reduce both the human health and ecological risks to acceptable levels

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Table 43 - Comparative Analysis of Alternatives (continued)

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls, Monitoring	Alternative 3 Soil/Sediment: Excavation and Off-site Disposal Surface water: Off-site Treatment and Disposal Groundwater: Extraction, Chemical Precipitation	Alternative 4 Soil/Sediment: Excavation and On-site Stabilization Water: Extraction, Constructed Wetlands
LONG TERM EFFECTIVENESS AND PERFORMANCE				
Magnitude of Residual Risk • Direct Contact/Soil Ingestion	• Current risk remains	• Reduces risk to the extent ICs are enforced	• Reduces risks to acceptable levels ($1x10^{-5}$, HQ=1)	• Reduces risks to acceptable levels ($1x10^{-5}$, HQ=1)
• Groundwater Ingestion for Current Users	• No current Users	• No Current Users	• No Current Users	• No Current Users
• Groundwater Ingestion for Potential Future Users	• Current risk remains	• Reduces Risk to the extent ICs are enforced	• Reduces risks to acceptable levels (MCL, HQ=1)	• Reduces risks to acceptable levels (MCL, HQ=1)
Adequacy and Reliability of Controls	Contaminants would remain onsite above health and ecological based levels. No controls.	Contaminants would remain on-site above health and ecological based levels. ICs would provide more reliability than No Action, but less reliability than other alternatives.	These alternatives are both adequate and reliable.	These alternatives are both adequate and reliable.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT				
Treatment Process Used • Soil/Sediment • Surface Water • Groundwater	None	None	• None • TBD • Chemical Precipitation	• Stabilization • Constructed Wetlands • Constructed Wetlands
Amount Destroyed or Treated • Soil/Sediment • Surface Water • Groundwater	None	None	• None • 500,000 gallons • TBD	• 1,600 cubic yards • 500,000 gallons • TBD
Reduction of Toxicity, Mobility or Volume	None	None	Reduces toxicity, mobility and volume	Reduces toxicity, mobility and volume
Irreversible Treatment	None	None	These alternatives provide for irreversible treatment for surface and groundwater, but no treatment for soil and sediment.	These alternatives provide for Irreversible Treatment for all media.
Type and Quantity of Residuals Remaining After Treatment	Contamination remains	Contamination remains	None	Stabilized mass ~ 2,100 cubic yards

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Table 43 - Comparative Analysis of Alternatives (continued)

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls, Monitoring	Alternative 3 Soil/Sediment: Excavation and Off-site Disposal Surface water: Off-site Treatment and Disposal Groundwater: Extraction, Chemical Precipitation	Alternative 4 Soil/Sediment: Excavation and On-site Stabilization Water: Extraction, Constructed Wetlands
SHORT-TERM EFFECTIVENESS				
Community Protection	Continued Risk to Community through No Action	Limited Community Protection to the extent that ICs are enforced.	Limited Risk to Community through off-site transportation	Minimal Risk to Community due to distance to nearest resident
Worker Protection	No risk to workers	Minimal risk to workers during sampling.	Protection required during excavation and handling of wastes.	Protection required during excavation and treatment of wastes.
Environmental Impacts	Continued impacts from existing condition	Continued impacts from existing condition	Negative impacts would be eliminated	Negative impacts would be eliminated. Constructed Wetlands would provide added environmental benefit of increased ecological habitat.
Time Unit Action is Complete	Not applicable	ICs could be in place in about 1 year.	Construction could be completed in about 3 months. Groundwater treatment would take ~30 years.	Construction could be completed in about 4 months. Groundwater treatment would take ~30 years.
IMPLEMENTABILITY				
Ability to Construct and Operate	No construction or operation.	No construction, easily sampled.	Easily constructed. Groundwater operation would require moderate effort.	Easily constructed. Groundwater operation would require minimal effort.
Ease of Doing More Action if Needed	Would require ROD amendment.	May require ROD amendment.	Easy	Easy
Ability to Monitor Effectiveness	5-Year Reviews	Monitoring is part of this alternative	Effectiveness is easily monitored by sampling and analysis.	Effectiveness is easily monitored by sampling and analysis.
Ability to obtain Approvals and Coordinate with Other Agencies	No Approval Necessary	Would require assistance from the State to implement ICs.	Would require coordination.	Would require coordination.
Availability of Equipment, Specialists and Materials	Not Applicable	Readily available	Readily available	Readily available
Availability of Technologies	Not applicable	Not applicable	Readily available	Readily available

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Table 43 - Comparative Analysis of Alternatives (continued)

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls, Monitoring	Alternative 3 Soil/Sediment: Excavation and Off-site Disposal Surface water: Off-site Treatment and Disposal Groundwater: Extraction, Chemical Precipitation	Alternative 4 Soil/Sediment: Excavation and On-site Stabilization Water: Extraction, Constructed Wetlands
COST				
Soil/Sediment Capital Cost Annual O&M Cost Present Worth Cost	 $0 *$2,240 $52,208	 $7,000 *$2,240 $84,837	 $166,547 $0 $166,547	 $490,390 *$2,240 $527,681
Surface Water Capital Cost Annual O&M Cost Present Worth Cost	 $0 *$3,200 $74,396	 $7,000 $15,960 $427,584	 $170,810 $0 $170,810	Included below with groundwater
Groundwater Capital Cost Annual O&M Cost Present Worth Cost	 $0 *$9,550 $222,535	 $7,000 $36,540 $921,830	 $243,600 $111,160 $2,593,406	 $492,100 $64,960 $1,884,660
STATE ACCEPTANCE				
Soil/Sediment	No	No	Yes	Yes
Surface Water	No	No	Yes	Yes
Groundwater	No	Yes	Yes	Yes
COMMUNITY ACCEPTANCE	*Difficult to assess due to receipt of only a few comments.*			
Soil/Sediment	No objections expressed	No objections expressed	As long as it's not an uncontrolled landfill.	Prefer selection of less expensive alternative
Surface Water	No objections expressed	No objections, but prefer selection of less expensive alternative	No objections expressed	No objections expressed
Groundwater	No objections expressed	No objections expressed	Prefer selection of less expensive alternative	No objections expressed

* Annual O&M for some of the alternatives are marked with an asterisk. This value isn't actual annual O&M but is the costs of the 5-year review divided by 5.

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2.11 Principal Threat Wastes

The NCP establishes and expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat waste combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. The contaminated soils in the scrap copper area and the contaminated sediments in the ponds are considered to be "principal threat wastes" because the chemicals of concern are found at concentrations that pose a significant risk to either human or ecological receptors. The ecological toxicity tests performed on soils and sediments from these areas showed significant toxicity with increased mortality and decreased growth.

The alternatives described in section 2.9 that would address these principal threat wastes are the ones for soil and sediment. Alternative 1, No Action, would not address the principal threats at the Site. Alternative 2, Institutional Controls, would only warn people of the contamination, but would not significantly reduce the risks posed by these principal threats. Alternative 3, Excavation and Off-Site Disposal, would significantly reduce the risks posed by these principal threats by removal, but not by treatment methods. It is not expected, based on the contaminant concentrations, that treatment would be required prior to off-site disposal. Alternative 4, Excavation and On-Site Stabilization, would significantly reduce the risks posed by these principal threats through treatment.

2.12 Selected Remedy

2.12.1 Summary of the Rationale for the Selected Remedy

2.12.1.1 Soil and Sediment

The Selected Remedy for Soil and Sediment is Alternative 3, Excavation and Off-Site Disposal. Although the NCP states that treatment of principal threats is preferred, wherever practicable, on-site treatment is not cost effective with the small volume of wastes. It is assumed at this point, that once excavated, the wastes will be determined to be a RCRA non-hazardous waste when analyzed by the TCLP method. If the soil and sediment is deemed as non-hazardous, treatment is not required prior to placement in a landfill. If this assumption is inaccurate and the soil and sediment are determined to be a RCRA hazardous waste, it will be treated prior to placement in an off-site landfill. Alternatives 1 and 2 do not treat or remove the principal threats, and are therefore not acceptable to either EPA nor the State. Alternatives 3 and 4 both significantly reduce the risks to human and ecological receptors. Alternative 3 is significantly less expensive than Alternative 4, and would not require a future 5-year review based on this media since all soil and sediment contaminated above clean-up levels would be removed from the Site.

2.12.1.2 Groundwater

The Selected Remedy for Groundwater is Alternative 2, Institutional Controls with Monitoring, with a contingency of Alternative 4, Extraction and Treatment Using Constructed Wetlands. The primary reason for the selected remedy is that it provides at least limited protection by restricting groundwater usage at the Site while additional data is collected to determine the accuracy of previous data. It is also believed that removal of the contaminated soil, sediment and surface water will reduce the concentrations that are migrating to groundwater. There are two contaminants of concern for which clean-up levels have been established for groundwater: aluminum and thallium. There is not a Federal nor a State Maximum Contaminant Level established for aluminum. The clean-up level derived for aluminum was for an HQ=1 from the Baseline Human Health Risk Assessment. Since there are no current on-site users of the groundwater, it is believed that this alternative is protective of human health. The highest concentration of thallium detected in groundwater at the Site was 8.4 ppb. The Federal MCL value is 2 ppb; there is no State MCL value. There are uncertainties with the thallium data as discussed near the end of section 2.7.1.5 in this ROD. It is questionable as to whether the results are actual concentrations or are "false positives".

Based on the above, EPA feels more data should be obtained before spending money constructing a potentially costly remediation system. If, after sufficient data has been obtained, the concentrations still remain consistently above the remediation levels, the contingency remedy, Alternative 4, Extraction and Treatment through Constructed Wetlands, will be implemented.

Alternative 4 was selected as the contingency remedy for several reasons. Of the two active remediation systems evaluated, this alternative is an innovative technology, is less expensive, requires less operation and maintenance, and provides an additional ecological habitat to the Site.

2.12.1.3 Surface Water

The Selected Remedy for Surface Water is Alternative 3, Off-Site Treatment and Disposal. Because Alternatives 1 and 2 do not provide protection to ecological receptors, they were not selected. Alternative 4, Treatment Using Constructed Wetlands, is only possible if that remedy is selected for groundwater remediation. Since constructed wetlands is not the immediate alternative selected for groundwater, Alternative 3 was chosen as the best alternative. It provides cost effective removal and treatment of the contaminated surface water, which reduces the risks to human and ecological receptors.

2.12.2 Description of the Selected Remedy

The selected remedy consists of Soil and Sediment Alternative 3 (Excavation and Off-Site Disposal), Surface Water Alternative 3 (Removal and Off-Site Treatment and

Disposal), and Groundwater Alternative 2 (Institutional Controls with Monitoring) with Groundwater Alternative 4 (Extraction and Treatment Using Constructed Wetlands) as a contingency. A Remedial Design and possibly Treatability Studies will be conducted prior to implementation. A detailed description of the selected remedy follows in the sequence that is expected.

2.12.2.1 Step 1 - Groundwater - Institutional Controls with Monitoring

Groundwater monitoring will take place annually, at a minimum, at the existing monitor wells and former production wells and the data will be evaluated. All groundwater samples will be analyzed for metals. Five-year reviews will be conducted to determine if contaminants that remain on-site are causing additional risk to human health or the environment. As a result of this review, EPA will determine if additional site remediation is required. When sufficient additional data has been received and reviewed, EPA will decide whether contamination is indeed real or was a result of previous problems with sampling or analytical techniques. If EPA, with the State's concurrence, determines that groundwater is no longer contaminated, the groundwater remedy will conclude. EPA will work with the State of North Carolina to place notices on the Site property deed(s) which will state that groundwater contamination potentially exists on the property. These recordations will remain in place until the groundwater quality improves enough to allow for unrestricted use.

2.12.2.2 Step 2 - Surface Water - Off Site Treatment/Disposal

The surface water that exceeds cleanup goals from the manmade ponds will be removed. There are five ponds on the site including a horseshoe shaped pond located on the northeast portion of the property. This horseshoe shaped pond is the largest on site but does not contain any contaminant levels above the clean-up levels. Therefore, this pond will not be included. The remaining four ponds will be addressed by this remedial action due to presence of contaminants in the ponded water or the sediment within the ponds. The surface water remedy will be implemented in conjunction with soil and sediment remedy that will remove the sediment and prevent further contamination of accumulated surface water in the ponds.

Surface water will be extracted from the ponds most likely using vacuum tanker trucks which will transport the water to an off-site facility for treatment. Prior to removal, samples of the water will be collected and analyzed for waste profiling that will determine the final treatment method. The treatment facility will have the RCRA permits with the State of North Carolina and EPA to accept and treat contaminated materials. The transporter will also be required to follow proper manifesting procedures as determined by the waste characterization analysis.

For estimating purposes, it is assumed that the depth of water in each pond is 4 feet. Pond 4 was observed to be dry during the remedial investigation and the ecological risk assessment. However, this may be affected by seasonal rainfall and was conservatively estimated with 4 feet of water. Therefore, the water volume breakdown is as follows:

Table 44 - Estimated Volume of Contaminated Surface Water

Pond	Dimensions	Water Depth	Volume (Ft^3)	Volume (Gallons)
1	110 feet x 60 feet	4 feet	26,400	197,472
2	50 feet x 80 feet	4 feet	16,000	119,680
3	70 feet x 40 feet	4 feet	11,200	83,776
4	60 feet x 70 feet	4 feet	16,800	125,664
TOTAL Volume (gallons)				526,592

Trucks utilized to transport the water to an approved treatment and disposal facility will enter designated areas of the site and will be directed to a specific loading area. Movement of the trucks will be kept to a minimum on-site to prevent the spread of contamination. Each truck must adhere to U.S. Department of Transportation (DOT) requirements for general bulk transportation and will follow manifesting procedures required by the disposal facility.

2.12.2.3 Step 3 - Soil and Sediment - Excavation and Off-site Disposal

After the contaminated pond surface water is removed, the soil and sediment remedy will be implemented. The FS indicated that seven areas have metals and/or PAH contamination in soils or sediment above clean-up levels. This contamination is from 0 to 1 foot below ground surface for all areas except Pond 2, which is estimated to extend to 5 feet below ground surface. WESTON calculated the areal extent of contamination assuming a conservative square pattern around each location with sample results exceeding the cleanup goal. The pattern was assumed to be 50 feet by 50 feet or half the distance to the nearest sample not exceeding a cleanup goal. WESTON then multiplied each area by the depth of contamination to determine the volume of soil/sediment requiring remediation. The approximate total volume is 1,600 cubic yards. A typical soil density of 100 pounds per cubic foot yields 1.35 tons per cubic yard. Therefore, the estimated 1,600 cubic yards of soil will yield 2,160 tons. The estimated volumes of soil from each area of concern are identified below:

Table 45 - Estimated Volume of Contaminated Soil and Sediment

Area	Dimensions	Depth	Volume (Ft^3)	Volume (Yd^3)
Scrap Copper	50 ft x 50 ft	1 ft	2,500	93
Pipe Shop	20 ft x 40 ft	1 ft	800	30
Drum Disposal	120 ft x 50 ft	1 ft	6,000	222
Pond 1	110 ft x 60 ft	1 ft	6,600	244
Pond 2	50 ft x 80 ft	5 ft	20,000	740
Pond 3	70 ft x 40 ft	1 ft	2,800	103
Pond 4	60 ft x 70 ft	1 ft	4,200	155
TOTAL Volume (cubic yards)				1,587

The surface soil and sediment that exceed cleanup goals will be excavated. The excavated soil and sediment and the decaying drums in the drum disposal area will be transported to an off-site permitted facility for landfilling as a regulated "non-hazardous" solid waste. The soil/sediment will be analyzed prior to transportation and disposal using the TCLP procedure to determine whether it is considered a RCRA hazardous waste. The FS assumed that the soil and sediments are not RCRA listed or characteristic waste. If the waste is a hazardous waste, it will be disposed off-site at a RCRA approved Subtitle C facility.

Prior to excavation, the following general site preparation would occur:

- Survey and mark the limits of the area to be excavated.
- Prepare an area for decontamination of excavation equipment.
- Construct a lined pad with curbs and sump for the collection of decontamination water. The wastewater would be stored and tested to determine final disposition.

Excavation will be performed with standard construction equipment consisting mainly of an excavator. Excavated materials would be placed on a lined staging area prior to loading into trucks for offsite disposal. Dust suppression by wetting the soil will be performed as necessary.

Trucks to transport soil and sediment to an approved disposal facility will enter designated areas of the site and will be directed to a specific loading area. Movement of the trucks will be kept to a minimum on-site to prevent the spread of contamination. Each truck must adhere to U.S. Department of Transportation (DOT) requirements for general bulk transportation and will follow manifesting procedures required by the landfill.

Upon excavation completion, the areas will be backfilled and graded to match the contour of adjacent undisturbed land. All areas disturbed by excavation will be revegetated or covered with crushed stone as appropriate.

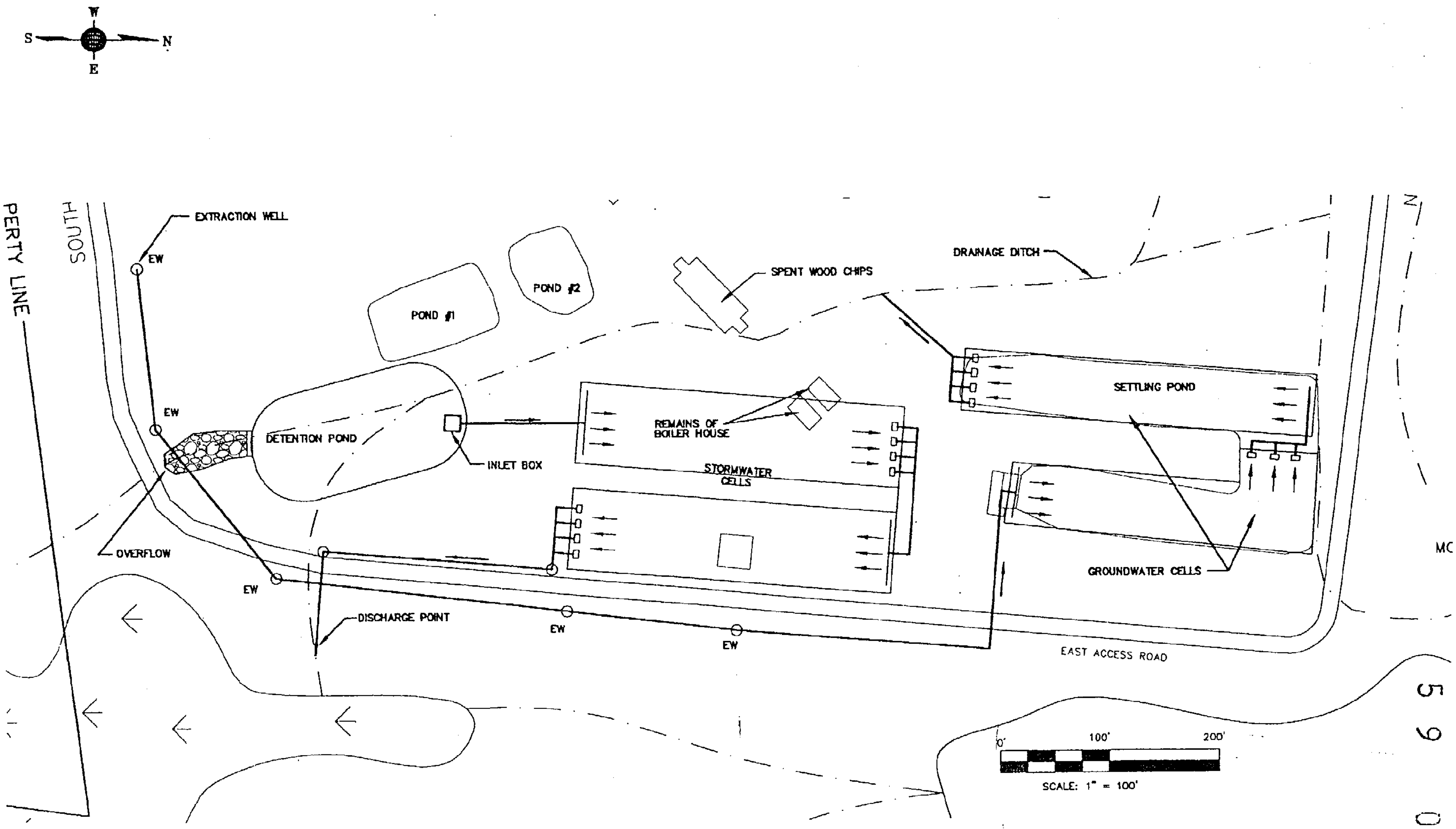
2.12.2.4 Step 4 - Groundwater (Contingent Remedy)

If, after numerous rounds of sampling data is obtained, EPA and the State determine that groundwater is indeed contaminated, the contingency remedy, Alternative 4, Extraction and Treatment Using Constructed Wetlands, will be invoked through an Explanation of Significant Differences (ESD). The constructed wetland approach to treating the groundwater and surface runoff from the Reasor Chemical Company Site consists of the application of two separate but similar wetland systems. The constructed wetland approach is basically providing nature with the materials it needs to bind and stabilize the pollutants into the soil of a developing peat bog. The contaminants and concentrations found in the Site groundwater have been compared to other projects which have utilized this treatment method, and it is believed that this method will successfully treat the contaminated groundwater. Figure 3 shows the proposed Constructed Wetland Conceptual Plan.

The groundwater treatment system proposed consists of installing five extraction wells along the southeastern boundary of the site and pumping the extracted groundwater to a dual cell constructed wetland located at the site of the existing settling pond in the northeast corner of the property. Initially, groundwater modeling will be used to model the groundwater recovery system. The FS assumed that the extraction wells would generate 2 gallons per minute (gpm) per well for a total flow of 10 gpm. The existing settling pond would be modified to become two wetland treatment cells operating in series. Each cell would have a water depth of 12 inches and be planted with a bulrush species. The existing pond area can provide approximately 63 hours of hydraulic detention time at 10 gpm to permit biochemical removal of the majority of the aluminum and thallium present. The treated effluent of the wetland cells would be discharged to the drainage ditch on site and flow through the storm water treatment system that will treat surface storm water.

If implemented, the construction should be scheduled to be completed and the wetland species planted in late April or May. The system will begin effective removal of pollutants immediately but will not be fully effective until the end of the second summer when the plants are mature. Construction of the proposed facilities would require dewatering the existing settling pond, demolishing the remains of the boiler house and concrete pad on the eastern portion of the site, bypassing the surface runoff through a temporary pipe to the east, excavating the detention pond and storm water cells, using the excavated soil for fill in the settling pond/groundwater cells, installing the necessary piping and hydraulic structures, installing the extraction wells and pumping system and final grading and grassing for erosion prevention. The hydrosoil would be designed, for example: soils selected from what is available and supplemented with fertilizer for the plants, organics as a carbon source, and materials to drive the biochemical reactions desired. Gypsum, for example, could be added to the hydrosoil to provide sulfides to react with and bind the copper and iron in the storm water.

Figure 3 - Constructed Wetlands Conceptual Plan



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2.12.3 Summary of the Estimated Remedy Costs

The selected remedy is expected to cost between $1.2 million and $2.45 million depending on whether the contingency remedy is needed. The lower value is the estimated cost for selected remedy: Soil/Sediment Alternative 3, Surface Water Alternative 3, and Groundwater Alternative 2 and is summarized in Table 46. The higher value is the sum of Soil/Sediment Alternative 3, Surface Water Alternative 3, Groundwater Alternative 4, and an additional $225,000 to account for the money spent on Groundwater Alternative 2 which would be implemented prior to Groundwater Alternative 4 (assuming 5 years of utilization of Alternative 2). Tables 47 through 50 provide detailed information on the costs for each component of the Remedy.

Table 46 - Estimated Costs for the Selected Remedy

	Soil/Sediment	Groundwater	Surface Water	Total
Total Capital Costs	$166,547	$7,000	$117,800	$289,347
Present Worth 5-yr Review Cost	$0	$37,921	$0	$37,921
Present Worth O&M Costs	$0	$877,539	$0	$877,539
Total Costs	$166,547	$921,830	$170,810	$1,204,807

Table 47 - Estimated Costs for Soil/Sediment Alternative 3, Excavation and Off-Site Disposal

Description	Quantity	Unit	Unit Cost	Total Cost
Capital Costs				
Project Plans	1		$30,000	$30,000
Erosion Control	1,000	feet	$5	$5,000
Mobilization and Set-up	1		$10,000	$10,000
Excavation	1,600	cubic yards	$5	$8,000
Waste Screening Analysis	2	each	$700	$1,400
Bulk Transportation	2,160[1]	tons	[2]$2.50	$5,400
Off-Site Disposal	2,160	tons	[3]$17.25	$37,260
Verification Sampling	7	each	$600	$4,200
Backfill	1,600	cubic yards	$6	$9,600
Regrade/Reseed	1		$4,000	$4,000
Subtotal				$114,860
Construction Management	1		5% of subtotal	$5,743
Engineering, Administration	1		15% of Subtotal	$17,229
Contingency	1		25% of Subtotal	$28,715
Total Capital Costs				$166,547
5-Year Review	0			$0
Present Worth 5-Year Review				$0
Estimated Annual O&M Costs	0			$0
Present Worth O&M Costs				$0
Present Worth Total (Capital+5-Year Review+O&M)				$166,547

Notes:
1) Tons calculated using a soil density of 100 pounds per cubic foot (1.35 tons/cy)
2) Bulk transportation assumes hauling with over the road dump trucks to the New Hanover County Landfill located approximately 10 miles from the Site.
3) Disposal rate assumes classification as regulated "non-hazardous" solid waste.

Table 48 - Estimated Costs for Groundwater Alternative 2, Institutional Controls with Monitoring

Description	Quantity	Unit	Unit Cost	Total Cost
Capital Costs:				
Deed Recordations	1	lump sum	$5,000	$5,000
Subtotal				$5,000
Administration	1		15% of Subtotal	$750
Contingency	1		25% of Subtotal	$1,250
Total Capital Costs				$7,000
5-Year Review	1 every 5 years	lump sum	$8,000	$8,000
Present Worth 5-Year Review				$37,291.20
Estimated Annual O&M Costs				
Sample Existing monitor and production wells	11	each	lump sum	$6,000
VOC, SVOC, Metals, and Dioxin Analysis	11	each	$1,600	$17,600
Report Preparation	1	each	lump sum	$2,500
Subtotal				$26,100
Administration	1		15% of Subtotal	$3,915
Contingency	1		25% of Subtotal	$6,525
Total Annual O&M				$36,540
Present Worth O&M Costs				$877,538.72
Present Worth Total (Capital+5-Year Review+O&M)				$921,829.92
Note: Total Present Worth O&M Cost assumes a 1.5% discount rate and annual groundwater monitoring over a 30 year period.				

Table 49 - Estimated Costs for Groundwater Alternative 4, Extraction and Treatment Using Constructed Wetlands

Description	Quantity	Unit	Unit Cost	Total Cost
Capital Costs:				
Engineering Design Services (Survey, Soil analyses, Drawings, Specifications, Permitting)	1	lump sum	$75,000	$75,000
Engineering Services During Bidding and Construction	1	lump sum	$35,000	$35,000
Extraction Well Installation	5	each	$5,000	$25,000
Piping	1	lump sum	$25,000	$25,000
Excavation of Pond & cells	1	lump sum	$50,000	$50,000
Cell Construction Earthwork	1	lump sum	$30,000	$30,000
Clay or GCL liners	1	lump sum	$35,000	$35,000
Hydraulic Appurtenances	1	lump sum	$15,000	$15,000
Erosion Control Installation & Maintenance	1	lump sum	$25,000	$25,000
Plants Installed	7500	each	$0.60	$4,500
Final Grading and Grassing	6	acres	$2,000	$12,000
Monitoring Station	1	each	$20,000	$20,000
Subtotal				$351,500
Administration	1		15% of Subtotal	$52,725
Contingency	1		25% of Subtotal	$87,875
Total Capital Costs				$492,100
5-Year Review	1 every 5 years	lump sum	$10,000	$10,000
Present Worth 5-Year Review				$46,614
Estimated Annual O&M Costs:				
Extraction Well Electricity	1	lump sum	$8,000	$8,000
Maintenance Labor	24	days	$625	$15,000
Sample Existing monitor and production wells	11	each	lump sum	$6,000
Metals Analysis of well samples	11	each	$200	$2,200
Analysis of Influent and Effluent Sampling (NPDES)	8	each	$650	$5,200
Report Preparation	1	each	lump sum	$5,000
Other Expenses	1	each	lump sum	$5,000
Subtotal				$46,400
Administration	1		15% of Subtotal	$6,960
Contingency	1		25% of Subtotal	$11,600
Total Annual O&M				$64,960
Present Worth O&M Costs				$1,345,945.94
Present Worth Total (Capital+5-Year Review+O&M)				$1,884,659.94

Note:
Total Present Worth O&M Cost assumes a 1.5% discount rate. Also assumes treatment to be performed over a 25 year period.

Table 50 - Estimated Costs for Surface Water Alternative 3, Off-Site Disposal

Description	Quantity	Unit	Unit Cost	Total Cost
Capital Costs:				
Project Plans	1	lump sum	$10,000	$10,000
Mobilization	1	lump sum	$5,000	$5,000
Waste Characterization Analysis	4	each	$700	$2,8800
Off-Site Disposal (T&D)	500,000	gallons	$0.20	$100,000
Subtotal				$117,800
Construction Management	1		5% of Subtotal	$5,890
Administration	1		15% of Subtotal	$17,670
Contingency	1		25% of Subtotal	$29,450
Total Capital Costs				$170,810
5-Year Review	0	lump sum		$0
Present Worth 5-Year Review				$0
Estimated Annual O&M Costs	0			$0
Present Worth O&M Costs				$0
Present Worth Total (Capital+5-Year Review+O&M)				$170,810

Notes:
1) Off-site disposal includes transportation (vacuum tanker) and disposal at treatment facility located in Southport, NC, approximately 40 miles south of Castle Hayne.
2) Water volume calculated using an average depth of 4 feet in all four ponds.
3) Disposal and treatment facility coordinated by Environmental Management Solutions of Greensboro, NC.

The information in the above cost estimate summary tables is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

2.12.4 Expected Outcomes of the Selected Remedy

2.12.4.1 Available Land Use after Cleanup

The clean-up levels chosen were based on residential, unrestricted use scenarios. After the soil/sediment and surface water portions of the remedy are completed (several months after they are initiated), the property would be available for residential, commercial or industrial uses with restrictions only on groundwater. The groundwater remedy may be completed in as little as a few years to as long as approximately 25 years (possibly longer). Until the groundwater remedy is complete, restrictions would be required to prevent the groundwater from being used on the property.

2.12.4.2 Final Clean-up Levels

The ecological risk assessment did not identify specific clean-up levels for the sediments because a concentration could not be created with the amount of information available. The recommendation was to remove all of the sediment to the clay layer and then fill the excavated ponds with clean soil. Therefore, specific cleanup levels were not derived for sediment. If the excavated ponds are filled with clean soil, it will eliminate them from being available to ecological receptors. Soil clean-up standards could then be applied. The Final Clean-up Levels for soil groundwater, and surface water, basis for cleanup levels, and risk at cleanup level (if appropriate) are included in Tables 51 through 53.

Table 51 - Soil Clean-up Levels

Media: Soil Available Use: Residential Controls to Ensure Restricted Use (if applicable): Not Applicable			
Chemical of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Benzo(a)pyrene	610 μg/kg	Human Health Risk Assessment	Cancer risk = $1x10^{-5}$
Benzo(b &/or k)fluoranthene	6,100 μg/kg	Human Health Risk Assessment	Cancer risk = $1x10^{-5}$
Dibenzo(a,h)anthracene	610 μg/kg	Human Health Risk Assessment	Cancer risk = $1x10^{-5}$
Antimony	30 mg/kg	Human Health Risk Assessment	Hazard Quotient = 1
Copper	2,700 mg/kg	Ecological Risk Assessment	Hazard Quotient = 0.96
Lead	400 mg/kg	EPA guidance	Not Available

Table 52 - Groundwater Clean-up Levels

Media: Groundwater Available Use: Residential Controls to Ensure Restricted Use (if applicable): Deed Restrictions			
Chemical of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Aluminum	16,000 μg/L	Human Health Risk Assessment	Hazard Quotient = 1
Thallium	2 μg/L	Federal MCL	Not Available

Table 53 - Surface Water Clean-up Levels

Media: Surface water Available Use: Residential Controls to Ensure Restricted Use (if applicable): Not Applicable			
Chemical of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Copper	7	NC Water Pollution Control Regulations	Not Available
Iron	1000	NC Water Pollution Control Regulations, Clean Water Act	Not Available
Lead	2.5	Clean Water Act	Not Available
Zinc	50 μg/L	NC Water Pollution Control Regulations	Not Available

2.12.4.3 Anticipated Environmental and Ecological Benefits

Removal of the contaminated soil, sediment and surface water will improve the quality of the ecological habitat that already exists on-site. Removing the contamination will eliminate contaminated run-off into the existing on- and off-site wetlands and the adjacent Prince George Creek. If the groundwater contingency remedy is implemented, two wetland systems will be constructed which will provide additional ecological habitats.

2.13 Statutory Determinations

2.13.1 Protection of Human Health and the Environment

The selected remedy will adequately protect human health and the environment through treatment, engineering controls, and/or institutional controls (NCP §300.430(f)(5)(ii)). Soil and sediment contaminants concentrations posing cancer risks of greater than $1x10^{-5}$ or Hazard Quotients greater than 1, will be removed from the Site and placed in an off-site landfill. Ponded surface waters which have concentrations greater than Federal or State surface water criteria will be removed from the Site, treated and disposed at an off-site facility. Notices will be placed on deeds warning potential property purchasers of potentially contaminated groundwater. The groundwater will be monitored until enough data is received to either deem the groundwater is not contaminated or it is clear that the groundwater contingency remedy should be implemented. If the contingency remedy is implemented, it will extract and treat the contaminated groundwater prior to discharge to Prince George Creek. The deed restrictions would remain in place until the groundwater is returned to adequate quality for unlimited use. All of these measures will reduce the risks to both human and ecological receptors. They are not expected to cause unacceptable short-term risks or cross-media impacts.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The Federal and State ARARs, potential ARARs and requirements which are To Be Considered, that are relevant to the Site and the Selected Remedy are presented in Table 52. The selected remedy will comply with all ARARs in Table 52 that are listed as either "Applicable" or "Relevant and Appropriate" under the "Status" column. Most of the requirements that are identified as "Potentially Applicable" relate to the contingency groundwater remedy, and would become "Applicable" if the groundwater contingency is invoked. Some "Potentially Applicable" requirements are dependent on further delineation (such as those related to wetlands, floodplains and endangered species). Wetlands and floodplains will be further investigated/delineated during the Remedial Design. One requirement is identified as "To Be Considered". It is the State's Guidelines for Assessment and Cleanup.

Table 53 - ARARs Attainment

Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Federal Requirements	All	Occupational Safety and Health Act (OSHA), 29 CFR Part 1910	Applicable	Regulates workers' health and safety	All personnel performing the selected remedy will comply with the requirements of this ARAR through the implementation of a Site-specific Health and Safety Plan.
Federal Requirements	Soil, Sediment & Surface Water	Hazardous Materials Transportation Act, 49 CFR Parts 107, 171-177	Applicable	Regulates transportation of Department of Transportation (DOT)-defined hazardous materials.	All DOT-defined hazardous materials will be handled as required by this ARAR. Transportation vehicles will be placarded appropriately and carry manifests for each load.
		Resource Conservation and Recovery Act, 40 CFR Parts 262 and 263	Applicable	Requirements for hazardous waste generators and for hazardous waste transporters	Handling and transportation of hazardous wastes will be performed in compliance with this ARAR.
		Endangered Species Act, 50 CFR Part 200, 402	Potentially Applicable	Requires action to conserve endangered species and/or critical habitats upon which endangered species depend.	No endangered species will be affected by the selected remedy. One butterfly and three plant species are identified as rare species within one mile of the site boundary.
		Fish and Wildlife Conservation Act, 16 U.S.C. § 2901 et seq.	Potentially Applicable	Requires adequate provision for the protection of fish and wildlife resources when any modification of any stream or other water body is proposed.	There are four water bodies that will be modified as a result of the selected remedy. There are no fish in any of these. The contaminant concentrations in these ponds are toxic. The selected remedy will protect wildlife by eliminating the source of contamination.

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Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
State Requirements	Soil and Sediment	Inactive Hazardous Sites Response Act of 1987 (North Carolina General Statute 130A-310 *et. seq.*), the associated *Guidelines for Assessment and Cleanup* (NC DENR), Inactive Hazardous Sites Program, 2001) and the soil/sediment remediation requirements detailed in Section 4 of the *Guidelines*.	To Be Considered	Establishes guidelines for voluntary clean-up actions.	NC DENR believes that the remedy will comply with this guideline.
Federal Requirements	Groundwater and Surface Water	CWA Part 301(b), Technology-based effluent limitations	Applicable	Establishes guidelines to determine effluent standards based on the Best Available Technology (BAT) economically available.	This ARAR will be complied with by the disposal facility (surface water). and will be used if the groundwater contingency remedy is invoked.
State Requirements	Groundwater and Surface Water	NC Water Pollution Control Regulations, NCAC Title 15A Subchapter 2B, Classification and Water Quality Standards Applicable to the Surface Waters and Wetlands of North Carolina	Applicable	Establishes a series of classifications and water quality standards for surface waters.	The on-site surface waters with contaminants greater than these standards will be removed from the Site. If the groundwater contingency remedy is implemented, the water leaving the treatment system will meet this requirement.
		NC Water Pollution Control Regulations, NCAC Title 15A Subchapter 2H, Procedures for Permits: Approvals, Point Source Discharges to the Surface Waters	Potentially Applicable	Requires permit for discharge of effluent from point sources into surface waters. State-level version of federal NPDES program.	The surface water disposal facility will be responsible for complying with this ARAR. If the contingency groundwater remedy is implemented, the substantive requirements of this ARAR will be met.

59 0100

Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Federal Requirements	Groundwater	National Primary Drinking Water Standards, 40 CFR Part 141	Relevant and Appropriate	Establishes health-based enforceable standards for public water systems (maximum contaminants levels (MCLs)).	The selected remedy will achieve MCLs as the clean-up level for the contaminants of concern.
		National Pollutant Discharge Elimination System (NPDES) Requirements, CWA Part 402, 40 CFR Part 122	Potentially Applicable	Requires permit for effluent discharge from any point source into surface waters of the United States.	If the contingency groundwater remedy is implemented, the substantive requirements of this ARAR will be met.
State Requirements	Groundwater	NC Drinking Water and Groundwater Standards, NCAC Title 15, Chapter 2, Subchapter 2L.0200 and 0.0201	Relevant and Appropriate	Groundwater Classifications and Standards. Establishes criteria for protection of state public water supplies	The Site groundwater is not currently a source for a public water supply. There are no State standards identified For the two groundwater contaminants of concern.
		Well Construction Standards, NCAC Title 15A Subchapter 2C.0100	Potentially Applicable	Criteria and Standards Applicable to Water-Supply and Certain Other Type Wells	If the contingency groundwater remedy is implemented, this ARAR will be met.
		NC Sedimentation Control Rules, NCAC Title 15A Subchapter 4B	Potentially Applicable	Erosion and Sediment Control	If the contingency groundwater remedy is implemented, this ARAR will be met.
Federal Requirements	Surface Water	CWA Part 303, 40 CFR Part 131, Water Quality Criteria	Applicable	Surface Water Quality Standards	The on-site surface water with concentrations exceeding this ARAR will be removed, and treated/disposed by an off-site facility.
Federal Requirements	Wetlands	Protection of Wetlands, Executive Order 11990, 40 CFR 6.302(a) and Appendix A	Potentially Applicable	Requires consideration of adverse impacts associ-ated with destruction or loss of wetlands and to avoid support of new construction in wetlands if practical alternative exists.	Wetlands are mapped at the southern site border. It is not anticipated that existing wetlands will be impacted by the selected remedy. The wetlands will be delineated during the Remedial Design.

5 9 0101

Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Federal Requirements	Flood plains	Flood plain Management, Executive Order 11988, 40 CFR 6.302, Appendix A	Potentially Applicable	Requires evaluation of potential effects of actions taken in a flood plain to avoid adverse impacts associated with direct and indirect flood plain development.	Certain areas in the southeastern site corner are subjected to 100-year flooding. Contaminant source areas are not located within mapped flood plains.

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2.13.3 Cost Effectiveness

This section explains how the Selected Remedy meets the statutory requirement that all Superfund remedies be cost-effective. A cost-effective remedy in the Superfund program is one whose "costs are proportional to its overall effectiveness". (NCP §300.430(f)(1)(ii)(D)). The "overall effectiveness" is determined by evaluating the following three of the five balancing criteria used in the detailed analysis of alternatives: (1) Long-term effectiveness and permanence; (2) Reduction in toxicity, mobility and volume (TMV) through treatment; and, (3) Short-term effectiveness. "Overall effectiveness is then compared to cost" to determine whether a remedy is cost-effective (NCP §300.430(f)(1)(ii)(D)).

For determination of cost effectiveness, a cost effectiveness matrix was utilized. In the matrix, the alternatives were listed in order of increasing costs. For each alternative, information was presented on long term effectiveness and permanence, reduction of toxicity, mobility and volume through treatment, and short term effectiveness. The information in those three categories was compared to the prior alternative listed and evaluated as to whether it was more effective, less effective or of equal effectiveness. The selected remedy is considered cost effective because it is a permanent solution that reduces human health and ecological risks to acceptable levels at less expense than some of the other permanent, risk reducing alternatives evaluated.

Table 54 - Cost Effectiveness Matrix

RELEVANT CONSIDERATIONS FOR COST EFFECTIVENESS DETERMINATION:					
Alternative	Cost Effective?	Present Worth Cost	Long Term Effectiveness and Permanence	Reduction of TMV[4] through Treatment	Short Term Effectiveness
Soil/Sediment					
1) No Action	No[1]	$52,208	No Reduction in Long Term Risk	No reduction of TMV	Continued Risk to Community & Environment
2) Institutional Controls	No[1]	$84,837	+ Minimal Reduction in Long Term Risk	= No reduction of TMV	+ Continued Risk to Environment
3) Off-Site Disposal	Yes	$166,547	+ Reduces Risks to Acceptable Levels	+ Reduction of TMV (but possibly not through treatment)	+ Controllable risk to workers, reduces other risks
4) On-site stabilization	Yes	$527,681	= Reduces Risks to Acceptable Levels	+ Reduction of Toxicity and Mobility, but not Volume through treatment	= Controllable risk to workers, reduces other risks
Groundwater					
1) No Action	No[1]	$222,535	No current users, no risk reduction to future users	No reduction of TMV	Only risks are for future residents and of migration
2) Institutional Controls with Monitoring	Yes[2]	$921,830	+ No current users, limited risk reduction to future users	= No reduction of TMV	+ Minimal risks for future residents if they do not heed notices. Risks of migration
4) Constructed Wetlands	Yes[2]	$1,884,660	+ Reduces Risks to Acceptable Levels	+ Reduction of TMV through treatment	+ Eliminates risks
3) Chemical Precipitation	Yes[2]	$2,593,406	= Reduces Risks to Acceptable Levels	= Reduction of TMV through treatment	= Eliminates risks
Surface Water					
1) No Action	No[1]	$74,396	No Reduction in Long Term Risk	No Reduction of TMV	Continued Risk to Community and Environment
3) Off-Site Disposal	Yes	$170,810	+ Reduces Risks to Acceptable Levels	+ Reduction of TMV through treatment	+ Controllable risk to workers, reduces other risks
2) Institutional Controls with Monitoring	No[1]	$427,584	- Minimal Reduction in Long Term Risk	- No Reduction of TMV	- Continued Risk to Community and Environment
4) Constructed Wetlands	Yes[3]	Included in G4	+ Reduces Risks to Acceptable Levels	+ Reduction of TMV through Treatment	+ Controllable risk to workers, reduces other risks

Notes:
1. These alternatives do not reduce risks to either human health or the environment and therefore are not considered cost effective.
2. Because groundwater contamination needs verification, all three of these methods are cost effective. The order of cost effectiveness would be Alternative 2, Alternative 4, Alternative 3.
3. Alternative 4 is only cost effective if used in conjunction with Groundwater Alternative G4.
4. TMV = Toxicity, Mobility and Volume

Key:
+ More effective than previous alternative
- Less effective than previous alternative
= No change in effectiveness over previous alternative

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2.13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable (MEP)

The selected remedy provides permanent solutions for all media and treatment for surface water and potentially groundwater. It does not provide for treatment of soil and sediment.

The selected remedy for soil and sediment, Off-site Disposal, provides for reduction of toxicity, mobility and volume, but not through treatment. The small volume of soil and sediment is thought not to be a hazardous waste under RCRA, therefore, not requiring treatment prior to disposal. It will be transported off-site, resulting in a permanent solution.

The selected remedy for groundwater is Institutional Controls with Monitoring, with the contingency of Extraction and treatment using Constructed Wetlands if groundwater concentrations remain elevated above clean-up criteria. Institutional Controls with Monitoring is being selected primarily because of uncertainty in the groundwater data. The contingency treatment technology is considered innovative. These are permanent solutions.

The selected remedy for surface water is Off-site disposal. The disposal facility will determine the treatment method needed prior to disposal. The contaminated water will be transported off-site, resulting in a permanent solution.

2.13.5 Preference for Treatment as a Principal Element

The selected remedy for surface water includes treatment. The selected remedy for soil, sediment and groundwater does not include treatment was a principal element. It is believed that the soil and sediment will not contain hazardous characteristics to require it to be considered a RCRA hazardous waste. Therefore, it would not require treatment prior to being placed in an off-site landfill. The groundwater needs further evaluation. If further analysis reveals groundwater is truly contaminated, the contingent remedy does include treatment.

2.13.6 Five-Year Requirements

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, but it will take more than five years to attain remedial action objectives and cleanup levels, a policy review may be conducted within five years of construction completion for the site to ensure that the remedy is, or will be, protective of human health and the environment.

2.14 Documentation of Significant Changes from Preferred Alternative of Proposed Plan

The Proposed Plan for the Reasor Chemical Company Site was released for public comment on July 11, 2002. The public comment period was from July 19, 2002, to August 18, 2002. The Proposed Plan identified Soil and Sediment Alternative S3 (Excavation and Off-Site Disposal), Groundwater Alternative G2 (Institutional Controls with Monitoring) and contingency Alternative G4 (Extraction and Treatment using Constructed Wetlands), and Surface Water Alternative SW3 (Off-Site Treatment and Disposal) as the Preferred Alternative for remediation. No written comments were received by EPA during the public comment period. EPA reviewed the verbal comments submitted during the public meeting, which was transcribed by a court reporter. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

PART 3: RESPONSIVENESS SUMMARY

No written comments were received during the public comment period. The only comments received were during the public meeting that was held on July 30, 2002. A copy of the transcript is in the Administrative Record. A brief summary of the major comments follow.

One person asked questions regarding the source of the funding for the site remediation. He expressed concern over taxpayer money being spent to clean-up a piece of property without the current owners contributing money towards the remediation of their property. He commented that the current owners "stand to make the money off of this thing, where you clean it up and they sell it." He wondered if the current owners or Reasor Chemical Co. had been contacted and requested to contribute to the clean-up. **RESPONSE:** Current and former property owners may be responsible for Site clean-up and liable for costs incurred in responding to conditions at the Site. EPA is in the process of identifying potentially responsible parties and investigating the viability of any such parties. In the future, potentially responsible parties may be asked to perform response actions at the Site and may be found liable for response costs incurred by EPA. Additionally, CERCLA authorizes EPA to place liens on property to address response costs in certain circumstances.

Another person commented that a lower cost alternative would be to purchase the property and prohibit use. **RESPONSE:** EPA is not in the land acquisition business. That alternative, if enforced, would reduce human health risks, but it would not address the threats posed to ecological receptors.

Another person commented that the soil and sediment have not yet been tested utilizing the TCLP procedure and that costs associated with Soil and Sediment Alternative 3 may be underestimated. **RESPONSE:** While that is true, based on the concentrations found at the site and professional judgement, it is believed that the assumption that the wastes will not be classified as a RCRA characteristic hazardous waste is reasonable. TCLP testing will be performed during the Remedial Design.

Another person commented that only two deep monitoring wells were installed on the property and wondered if this was sufficient to thoroughly evaluate the groundwater condition. **RESPONSE:** There are three wells (production wells) that were existing on the property that are in the deep aquifer. Two of them (PW-2 and PW-3) are located in the southwest corner of the Site and the other one (PW-1) is located in the northeast corner of the Site. During the RI, two permanent monitor wells were installed at the Top of Bedrock depth (MW-4D and MW-6D). Well MW-6D is located in the northwest corner of the Site, and well MW-4D is located in the southeast corner of the Site. The direction of groundwater flow at the site is from the northwest corner to the southeast corner. Wells PW-2, PW3, and MW-6D are considered upgradient of the Site contamination. Well MW-4D is downgradient in the groundwater flow direction, at the point where groundwater would migrate off-site. When well MW-4D was sampled in 1997, the results were below the groundwater clean-up levels identified in this ROD. Because no deep wells exist in the portion of the site with the highest amount of soil and sediment contamination, the deeper aquifer may not be fully characterized. However, if the deeper aquifer is contaminated and the contaminants migrate, they should eventually appear in well MW-4D. Another deep well is planned to be installed during the Remedial Design.

PART 4: REFERENCES

The references listed below are the documents used in writing this ROD. In several sections of the ROD (e.g. section 2.7), sources were identified that are not included in this Part. Those sources weren't directly looked at in the preparation of this document, and are cited in the references of some of the following (e.g. risk assessments).

1. EPA, 2002. Proposed Plan Fact Sheet, Reasor Chemical Company Site, Castle Hayne, New Hanover County, North Carolina (July 2002)

2. EPA, 2002. Memorandum from Samantha Urquhart-Foster to file, titled, Clean-up Values for Soils and Groundwater, Reasor Chemical Company Site (July 3, 2002).

3. EPA and Integrated Laboratory Systems, Inc., July 1, 2002. Field Investigation Report and Ecological Risk Characterization, Reasor Chemical Company Site, Castle Hayne, New Hanover County, North Carolina

4. EPA and Integrated Laboratory Systems, Inc. February 28, 2002. Problem Formulation Baseline Ecological Risk Assessment, Reasor Chemical Company Site, Castle Hayne, New Hanover County, North Carolina

5. EPA, 2001. E-mail from Elmer Akin with the attached document titled, Arsenic in Soil: EPA Region 4 Position On Risk Assessment and Risk Management Clean-Up Levels (June 25, 2001).

6. EPA, 2001. Comprehensive Review Guidance (EPA 540-R-01-007, OSWER No. 9355.7-03B-P, June 2001). Available at http://www.epa.gov/superfund/resources/5year/guidance.pdf

7. EPA, 2001. OTS Alert #2 (January 31, 2001).

8. EPA, 2001. Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action (EPA/530/R-01/015, September). Available at http://www.epa.gov/correctiveaction/resource/guidance/gw/gwhandbk/gwhbfinl.pdf

9. EPA, July 1999. A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents (EPA 540-R-98-031, OSWER 9200.1-23P, PB98-963241, July 1999).

10. EPA, 1990. National Oil and Hazardous Waste Contingency Plan (55 FR 8666 and 40 CFR 300).

11. Integrated Laboratory Systems, Inc., 2002. Toxicity And Bioaccumulation Potential of Sediment And Soil Samples from the Reasor Chemical Company Site, Castle Hayne, North Carolina, July 2002.

12. Norton, Schell & Braswell, Inc., 2002. Transcript of the Proposed Plan Presentation, Reasor Chemical Company Site, Tuesday, July 30, 2002, 7:00 PM.

13. Roy F. WESTON, Inc., July 2002. Focused Feasibility Study, Reasor Chemical Company Site, Castle Hayne, New Hanover County, North Carolina

14. Roy F. WESTON, Inc., December 1999. Remedial Investigation Report, Reasor Chemical Company Site, Castle Hayne, New Hanover County, North Carolina

15. Roy F. WESTON, Inc., December 1999. Baseline Human Health Risk Assessment, Reasor Chemical Company Site, Castle Hayne, New Hanover County, North Carolina

16. Roy F. WESTON, Inc., December 1999. Screening-Level Ecological Risk Assessment, Reasor Chemical Company Site, Castle Hayne, New Hanover County, North Carolina

17. Roy F. WESTON, Inc., 1992. Reasor Chemical Company Site, Castle Hayne, New Haven, North Carolina, TDD# 04-9112-0014-2155, TAT # 04-F-00503. (22 January 1992)